Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

A Formative Acceptability Study of a Technology Assisted Platform for Delivering Caregiver Skills Training in Rural Pakistan

Hadia Maryam[1]

hadia.maryam@hdrfoundation.org

Human Development Research Foundation

Huma Nazir[1]

Human Development Research Foundation

Mahjabeen Tariq[1]

Human Development Research Foundation

Muqadas Hayyat[1]

Human Development Research Foundation

Ahmreen Koukab[1]

Human Development Research Foundation

Rakhshanda Liaqat[1]

Human Development Research Foundation

Maria Kanwal[1]

Human Development Research Foundation

Atif Rahman[2]

University of Liverpool

Research Article

Keywords: Caregiver skills training, Neurodevelopmental delays, Technology-assisted intervention, Acceptability, Non-specialist providers, Rural Pakistan

Posted Date: November 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11143532/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Scaling non-specialist-delivered psychosocial interventions requires infrastructure for provider training, supervision, quality assurance, monitoring and referral. Developing these functions separately for each intervention can create fragmented systems and duplicate resources. The Technology-Assisted Platform for Mental Health (TAP) was developed as reusable digital implementation infrastructure that facilitates task-shifted intervention delivery and initially validated for a perinatal depression intervention. This study examined whether the substantially different World Health Organization Caregiver Skills Training programme (WHO CST) could be configured within TAP and assessed the preliminary prototype's acceptability in rural Pakistan.

Methods

A two-phase formative study was conducted in rural Rawalpindi District between September 2025 and July 2026. First, four multidisciplinary workshops mapped CST's content, delivery processes and implementation requirements onto the existing TAP architecture. Three family peer-provider dyads then undertook simulated usability testing, informing iterative prototype refinement. Second, TAP-CST was field-tested, followed by qualitative interviews with CST trainers (n = 2), family peer-providers (n = 2) and caregiver-users (n = 3). Interviews were informed by the Theoretical Framework of Acceptability and analysed using framework analysis.

Results

CST's nine group sessions and three home visits were configured as structured digital workflows without altering their core content or sequence. CST-specific processes were incorporated across TAP's six implementation functions: identification and screening, competency-based training, intervention delivery and decision support, supervision, monitoring and outcome assessment, and risk management and referral. Simulated testing identified minor problems involving navigation, video access and session flow, which were addressed before field testing. Across participant groups, TAP-supported delivery was viewed as acceptable, useful and contextually relevant. Family peer-providers valued having structured guidance, activities and videos available at the point of delivery, reducing reliance on recalled training and increasing perceived confidence. Trainers reported greater continuity between provider preparation and intervention delivery. Caregiver-users found provider-facilitated videos and activities understandable and applicable to interactions with their children. Acceptability was therefore associated with the combination of accessible digital guidance and family peer-provider support, rather than digitisation alone. The longer-term operation of supervision, monitoring and referral functions was not established.

Conclusions

WHO CST could be configured within TAP while preserving its core intervention content and delivery structure. The preliminary prototype was acceptable to trainers, family peer-providers and caregiver-

users, providing early support for TAP's potential as reusable implementation infrastructure across different psychosocial interventions. Larger-scale studies should evaluate provider competence, fidelity, effectiveness, equitable reach, costs and sustainability.

INTRODUCTION

Children with neurodevelopmental conditions, including intellectual disability, autism and developmental delay, account for a substantial proportion of childhood disability worldwide [1]. The burden falls disproportionately on low- and middle-income countries (LMICs), where specialist developmental and mental health services are scarce and concentrated in urban centres [2]. Consequently, many children receive little or no formal support, while caregivers manage communication difficulties, behavioural challenges and functional needs with limited guidance [3]. These unmet needs affect children's development and participation as well as caregiver well-being, family functioning and household resources [4].

Caregiver-mediated interventions offer a potentially scalable response by equipping caregivers with practical strategies that can be incorporated into everyday interactions and routines [5, 6]. The World Health Organization developed the Caregiver Skills Training programme (WHO CST) for caregivers of children aged 2–9 years with developmental disorders or delays [3]. CST is a transdiagnostic, family-centred intervention comprising nine group sessions and three individual home visits. It addresses caregiver–child engagement, communication, daily living skills, challenging behaviour and caregiver well-being. The programme is designed for delivery by trained non-specialists, does not require children to have a formal diagnosis and permits contextual adaptation while preserving its core principles [3]. In Pakistan, CST has been culturally adapted for rural communities including digitalisation of content, and previous research has demonstrated the feasibility and effectiveness of delivery through trained family volunteers [7].

However, an intervention's digitalisation for task sharing does not by itself ensure its scalability. Wider implementation requires systems for identifying eligible families, training and assessing providers, supporting intervention delivery, providing supervision, monitoring quality and outcomes, and managing risk and referral. In low-resource settings, these functions often depend on scarce specialists and are developed separately for each intervention [8]. This can create fragmented programmes, duplicate implementation resources and make it difficult to maintain provider competence and intervention quality as delivery expands. Technology may help address these constraints, but its contribution depends on supporting the wider implementation system rather than simply converting intervention materials into electronic form.

The Technology-Assisted Platform for Mental Health (TAP) was developed as reusable digital infrastructure for peer- and non-specialist-delivered psychosocial interventions [9]. TAP integrates six linked implementation functions: identification and screening; competency-based training; structured intervention delivery and decision support; supervision; monitoring and routine outcome assessment;

and risk management and referral. Intervention-specific content can be configured within this common architecture, while providers remain responsible for the relational and contextual elements of care. TAP was initially configured for the WHO Thinking Healthy Programme, a psychological intervention for perinatal depression. In a cluster-randomised non-inferiority trial in rural Pakistan, peer-delivered TAP-supported care was non-inferior to conventional delivery by community health workers [10], while associated research demonstrated the platform's potential to support provider training, supervision and integration with primary health and community care [11].

Whether the same digital architecture can support interventions with substantially different populations, content and delivery processes remains uncertain. CST provides a meaningful test of this transferability. Unlike the Thinking Healthy Programme, CST targets caregivers of children with heterogeneous neurodevelopmental conditions and seeks to change caregiver–child interactions and children's developmental and behavioural outcomes. It therefore requires different provider competencies, session workflows, training materials, outcome assessments and referral pathways. Configuring CST within TAP offers an opportunity to examine whether common digital implementation infrastructure can accommodate these distinct requirements while preserving CST's core intervention components.

This study therefore aimed to: (1) examine the configurational feasibility of integrating WHO CST content and delivery processes within the existing TAP architecture; and (2) explore the acceptability of the resulting preliminary TAP-CST prototype among CST trainers, family peer-providers and caregiver-users in rural Pakistan. In doing so, the study provides an initial assessment of TAP's potential to function as reusable implementation infrastructure across different non-specialist-delivered psychosocial interventions.

METHODS

Study design

We conducted a two-phase formative study to examine the configurational feasibility and acceptability of integrating the World Health Organization Caregiver Skills Training programme (WHO CST) within the Technology-Assisted Platform for Mental Health (TAP). Configurational feasibility was defined as the extent to which CST content and delivery processes could be incorporated into the existing TAP architecture while preserving the intervention's core components and accommodating its distinct implementation requirements.

The study comprised:

1. Participatory configuration of CST within TAP, followed by simulated usability testing and iterative refinement of the preliminary prototype; and
2. Field testing and a qualitative evaluation of the acceptability of TAP-CST among CST trainers, family peer-providers and caregiver-users.

The study was conducted in rural Rawalpindi District, Punjab, Pakistan, between September 2025 and July 2026.

Technology-Assisted Platform for Mental Health

TAP is a modular, Android-based platform designed to support the delivery of evidence-based psychosocial interventions by peers and other non-specialist providers in low-resource settings [11]. Providers access TAP through smartphones. Intervention content and delivery workflows are stored on the device, allowing materials to be used when internet connectivity is unavailable or intermittent. Data can be collected offline and synchronised when connectivity becomes available.

TAP combines intervention delivery with six linked implementation functions: identification and screening; competency-based provider training; structured intervention delivery and decision support; provider supervision; monitoring and routine outcome assessment; and risk management and referral. The platform was initially developed and configured for the WHO Thinking Healthy Programme for perinatal depression [11]. However, the platform was developed with the aim to incorporate other psychosocial interventions within the same architecture, so that non-specialist providers develop familiarity and ease of navigation through various functions of implementation.

WHO Caregiver Skills Training

WHO CST is a transdiagnostic, family-centred intervention for caregivers of children aged 2–9 years with developmental disorders or delays. It does not require children to have a formal diagnosis. The programme comprises nine group sessions and three individual home visits and addresses caregiver–child engagement, communication, daily living skills, challenging behaviour and caregiver well-being [13, 14].

CST had previously been culturally adapted and evaluated in rural Pakistan, including digital delivery through family volunteers [7]. The present study retained the content, structure and intended delivery processes of this existing CST programme while configuring them within the TAP architecture. For details about the digital adaptation of CST to the Pakistani rural context, the readers are referred elsewhere [15].

Phase 1: Configuration and prototype development

Configuration workshops

Four structured configuration workshops were conducted to map CST content and delivery processes onto the existing TAP architecture. A total of 11 participants were involved, including 3 CST trainers, 1 psychologist, 2 intervention specialists, 3 technology developers, and 2 family peer-providers.

Participants were selected based on their relevant expertise and experience in CST, psychosocial interventions, technology development, or community-based delivery.

During the workshops, participants reviewed the CST intervention, session structure, provider materials, participant materials, videos, activities, training requirements, supervision processes, outcome measures and referral pathways. Each component was mapped against the relevant TAP function. The workshops considered:

- whether CST's nine group sessions and three home visits could be represented as structured digital workflows;
- how facilitator's and participants' materials, activities and videos should be organised within each workflow;
- what guidance and decision support family peer-providers would require during sessions;
- how CST-specific training and provider competencies could be incorporated;
- what information supervisors would require to monitor delivery and support providers;
- how implementation and outcome data should be recorded; and
- how risk-management and referral procedures should be represented.

The configuration process distinguished between CST components that needed to remain unchanged to preserve the intervention's core functions and elements that could be adapted for digital presentation or local delivery. Core CST components were identified through review of the WHO CST manuals and existing culturally adapted materials, informed by the intervention's underlying principles and the experience of CST trainers and intervention specialists. Configuration decisions were recorded in a structured mapping matrix linking each CST component to the relevant TAP function. Proposed adaptations were reviewed iteratively by the CST and technology teams, with disagreements resolved through discussion and final configurations agreed by consensus.

Simulated usability testing

The preliminary prototype was assessed through simulated usability testing involving three dyads of family peer-providers. Within each dyad, one participant assumed the role of the provider and the other the role of a caregiver-user. Participants worked through selected TAP-CST components and completed tasks involving navigation, locating session materials, accessing and replaying videos, following the session sequence, using discussion prompts, pausing a session and entering notes.

Members of the research team observed the simulations and documented navigation problems, questions, errors and participant suggestions using an observation checklist. After each simulation, participants were invited to describe difficulties encountered and recommend improvements. Findings were reviewed by the intervention and technology teams and used to refine the prototype before field testing. The prototype was considered ready for field testing when participants could complete the representative session workflows, access the required instructions and videos in the intended sequence,

and use the principal navigation, break and notes functions without unresolved errors that could disrupt intervention delivery. Minor usability issues identified during testing were addressed before progression.

Phase 2: Field testing and acceptability evaluation

Setting, participants and procedures

Field testing was undertaken in Mangote Union Council, a geographically dispersed rural area of Rawalpindi District with a population of approximately 50,000. The area is served by a primary healthcare facility and a network of community health workers but has limited specialist developmental and child mental health services. Families seeking care for children with neurodevelopmental conditions commonly face barriers related to distance, cost, limited availability of trained professionals and stigma [6].

The setting was selected because it provided an established community infrastructure through which family peer-providers, supported by a local nongovernmental organisation, could deliver CST and connect families with primary healthcare and referral services when required.

Participants and recruitment

Participants for the qualitative acceptability evaluation were purposively selected from three groups representing different perspectives across the TAP-CST delivery process:

- **CST trainers**: Individuals with prior experience in CST training, delivery, and/or supervision were eligible to participate. They were selected based on their direct involvement in preparing and/or supervising family peer-providers using TAP-CST. Individuals without relevant CST training, delivery, or supervision experience were not included.
- **Family peer-providers**: Caregivers of children participating in CST were considered for the family peer-provider role. Caregivers who were motivated and willing to support other families and volunteered to take on the provider role were selected for training. Those who completed the required CST training and subsequently used TAP-CST during field testing were included as family peer-providers in the qualitative evaluation. Caregivers who did not volunteer for the provider role or did not complete the required training were not included in this group.
- **Caregiver-users**: Caregivers who had received all nine TAP-supported CST group sessions and at least two individual home visits were eligible to participate. This ensured that participants had sufficient exposure to the final TAP-CST configuration to comment on its acceptability and usability. Caregivers who had not received the required intervention exposure were not included.

Eligible participants were identified from individuals involved in the TAP-CST preparation, training, field testing, and delivery activities and were approached by the study team to participate in individual qualitative interviews.Participation was voluntary, and written informed consent was obtained before the interviews. No participant declined participation or withdrew from the qualitative evaluation.

Purposive sampling sought variation in participant role, CST experience, and level of exposure to TAP-CST. The family peer-provider sample included 2 mothers of children participating in CST who were new to the TAP platform and had no previous experience of using TAP to deliver the Thinking Healthy Programme. This enabled exploration of usability, burden, and acceptability of TAP-CST among family peer-providers who had experience as caregivers and CST providers but no prior experience using TAP for THP delivery.

Field-testing procedure

The refined TAP-CST prototype was used by 2 trained family peer-providers to deliver CST to 4 caregiver groups comprising 20 caregivers in total, with 5 caregivers per group. Each group received nine weekly CST sessions over a maximum exposure period of approximately 12 weeks, along with two to three individual home visits per family. The field testing was conducted in the community in Mangote Union Council, Rawalpindi District, from February, 2026 to April, 2026. A total of 7 supervision contacts were provided: 4 weekly sessions during the first four weeks, 2 fortnightly sessions during weeks 5–8, and 1 monthly follow-up during the final four weeks. Supervision focused on reviewing session delivery, identifying implementation problems, and supporting providers in addressing issues arising during delivery.

During field testing, TAP-CST was used for identification and screening, intervention delivery, and supervision. Family peer-providers used TAP-CST to access session objectives, instructions, activities, videos, and decision-support guidance during delivery. Caregiver-users experienced the digital content through provider-facilitated sessions and were not required to own or operate a smartphone

Qualitative interviews were conducted after participants had completed all nine CST sessions and at least two home visits. This ensured that interviewees could draw on direct experience of training with, delivering, supporting or receiving the configured intervention.

Qualitative data collection

Individual semi-structured interviews explored participants' experiences of TAP-CST. Topic guides were informed by the Theoretical Framework of Acceptability, which conceptualises acceptability across seven domains: affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness and self-efficacy [14].

For trainers and family peer-providers, interviews explored experiences of learning and navigating the platform; accessing intervention materials; following digital workflows; using videos and activity guidance; delivering or supporting sessions; and using the training, supervision, monitoring and referral functions. Interviews also examined perceived effects on confidence, workload and delivery quality, as well as technical or contextual difficulties and suggested refinements.

Caregiver-user interviews focused on the experience of receiving TAP-supported CST, the clarity and relevance of digitally presented materials, the contribution of videos and provider guidance, perceived

burden or inconvenience, and the appropriateness of the approach for their families and communities. Because caregiver-users did not operate the platform directly, questions distinguished their experience of technology-supported delivery from the usability of the provider-facing interface.

Interviews were conducted in Urdu by a female research assistant with a master's degree and training in qualitative research. The interviewer was an independent researcher and had no direct relationship with the participants. Interviews were conducted in participants' homes and lasted approximately 40–65 minutes. Interviews were conducted during May and June 2026. With participants' consent, interviews were audio-recorded. The interviewer also completed field notes after each interview to document relevant contextual observations and reflections.

Data collection continued until no substantively new findings were identified within the participant groups.

Transcription and translation

Audio recordings were transcribed verbatim in Urdu and translated into English for analysis. Translation quality was checked through independent review. Potentially identifying information was removed during transcription.

Data analysis

Interview data were analysed using framework analysis [16]. The analysis combined deductive coding based on the seven domains of the Theoretical Framework of Acceptability with inductive coding to capture findings not adequately represented by the framework.

Analysis proceeded through five stages: familiarisation with the transcripts; development of an initial analytical framework; indexing of the data; charting into a framework matrix; and interpretation of patterns within and across participant groups. Initially, two researchers independently reviewed one transcript from each participant group. They compared interpretations and refined the coding framework through discussion. The agreed framework was then applied to the remaining transcripts manually. Coding disagreements were resolved through discussion and, where necessary, consultation with the wider research team.

Separate matrices were developed for CST trainers, family peer-providers and caregiver-users. The research team compared findings across groups to identify convergence, divergence and participant-specific concerns. Particular attention was paid to differences between participants who interacted directly with TAP and caregiver-users who experienced the platform through provider-facilitated sessions. Differences between family peer-providers with and without previous TAP experience were also examined.

The analysis sought both positive and negative cases. Participants' proposed changes were examined alongside observational findings from simulated testing to identify areas requiring further refinement. Quotations were selected to illustrate the range of views rather than only the most favourable accounts.

Methodological rigour and reflexivity

Several procedures were used to strengthen the credibility and dependability of the analysis: use of a theoretically informed topic guide; inclusion of three participant groups; comparison of findings across groups; independent review of a subset of transcripts; maintenance of an analytical decision trail; and discussion of emerging interpretations within the multidisciplinary research team.

The multidisciplinary research team included psychologists, qualitative researchers, CST trainers, intervention specialists and researchers involved in developing or evaluating TAP. Some team members therefore entered the study with prior knowledge of, and investment in, the intervention's potential. Interviewers were not directly responsible for delivering CST to the participants they interviewed, and participants were encouraged to discuss negative experiences and suggested improvements as well as perceived benefits. Reflexive notes were maintained during data collection and analysis, and emerging interpretations were reviewed by researchers with differing levels of involvement in TAP-CST. The team actively examined contradictory and negative cases and used group discussion to distinguish participants' accounts from researchers' prior assumptions.

Ethical considerations

The study was approved by the Institutional Review Board (IRB) of the Human Development Research Foundation (HDRF), Pakistan. The research was conducted in accordance with the applicable ethical guidelines and regulations. Written informed consent was obtained from all participants before their participation in the study. Participants were informed that participation was voluntary, that declining would not affect access to services and that they could withdraw without providing a reason.

Confidentiality and anonymity were maintained throughout data collection and analysis. Audio recordings, transcripts and study data were stored securely and were accessible only to authorised research-team members. No significant distress or safeguarding concerns arose during the interviews. Participants were reminded that they could pause or stop the interview at any time if they felt uncomfortable.

Reporting guideline

The qualitative components of this study were reported with reference to the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [17].

RESULTS

Participant characteristics

Phase 1 involved four multidisciplinary configuration workshops attended by 3 CST trainers, 1 psychologist, 2 intervention specialists, 3 technology developers, and 2 THP Tap peer-providers (n = 11).

Subsequent simulated usability testing involved three dyads of family peer-providers and caregiver-users.

Phase 2 included CST trainers (n = 2), family peer-providers (n = 2), and caregiver-users (n = 3). The family peer-providers were mothers of children with neurodevelopmental delays who had volunteered to support other families and had completed the required CST training. Neither family peer-provider had previous experience using TAP to deliver the Thinking Healthy Programme. Caregiver-users were caregivers of children with neurodevelopmental delays who had received all nine TAP-supported CST group sessions and at least two individual home visits.

Phase 1: Configuration of CST within TAP

The configuration workshops established that the CST intervention could be accommodated within the existing TAP architecture without altering its core delivery structure. The nine group sessions and three individual home visits were converted into session-specific digital workflows. Facilitators and participants' materials, videos, activities, instructions and checklists were linked to the relevant sessions and arranged in the intended sequence.

CST-specific requirements were incorporated across TAP's six linked implementation functions.

Identification and screening

The Ten Questions Screen was incorporated into the workflow to support the identification and enrolment of potentially eligible children and caregivers. [18, 19]

Competency-based training

CST training materials were incorporated into the provider-training component. Provider competence was assessed using the Enhancing Assessment of Common Therapeutic Factors Rating Scale.[20]

Intervention delivery and decision support

The nine group sessions and three home visits were configured as structured workflows. Providers could access the relevant session objectives, instructions, activities and videos at the point of delivery. Decision-support features were adapted to guide session delivery and responses to difficulties arising during sessions.

Supervision

Information on assigned caregivers, completed sessions, provider workload and reported delivery problems was made available to supervisors. These data could be reviewed during group supervision, with individual support provided when necessary.

Monitoring and outcome assessment

Delivery data were integrated with supervision to monitor session completion, workload and implementation difficulties. Routine outcome measures were incorporated at the relevant assessment points.

Risk management and referral

A CST-specific referral tree was embedded within the platform to guide providers and supervisors when a child or caregiver required further assessment, clinical support or referral.

This mapping produced an initial TAP-CST prototype that retained CST's intervention-specific content and processes within TAP's established implementation architecture.

Phase 1: Usability testing and prototype refinement

During simulated testing, three family peer-provider dyads used the prototype in provider and caregiver roles. Testing examined navigation, access to session materials and videos, session sequencing, discussion prompts, and the break and notes functions.

Participants were able to navigate the workflows and locate the materials required for each session. Testing identified minor difficulties related to video presentation and selection, forward and backward navigation, and sequencing of session content. Refinements included improving video access and selection through a dropdown menu, simplifying button and icon labels, adding a break function, introducing a dropdown for discussion points, and adding a dedicated notes function. The revised prototype was subsequently used during field testing.

Phase 2: Acceptability of TAP-supported CST

The overarching finding was that TAP-CST was acceptable because it provided structured guidance and intervention materials at the point of delivery while preserving the family peer-provider's central role. Acceptability was associated with three related features: the organisation of CST content into clear session workflows, the accessibility of videos and activity guidance during delivery, and continuity between provider training and practice.

Affective attitude and intervention coherence

Participants across all three groups expressed positive attitudes towards TAP-supported CST. Family peer-providers described the platform as giving them a clear structure for conducting sessions because the required content and guidance were available in one place. One provider explained:

"The platform gave me a clear structure for conducting the session because the required material was available in one place. Once I became familiar with the platform, I felt more comfortable using it during the sessions." (PP01)

The session-specific organisation of materials helped providers understand what was required at each stage and follow the intended intervention sequence. Trainers similarly considered the digital workflows consistent with the structure of CST:

“The CST components were organized within the platform according to the session structure. This gave the provider access to the relevant material while maintaining the sequence of the intervention.” (CST-T01)

Caregiver-users reported that the combination of provider explanation, practical activities and video demonstrations made sessions understandable. They particularly valued providers discussing the video examples and relating them to the caregiver’s own circumstances:

“The session content was explained in a way that I could understand. When the provider showed the video and then discussed it with us, the topic became clearer for me.” (CU02)

Thus, coherence was supported by both the organisation of the digital content and the family peer-provider’s role in interpreting and contextualising it.

Perceived burden and opportunity costs

Ease of use increased as family peer-providers became familiar with the platform. Providers who were new to TAP reported an initial learning period but described becoming more comfortable through practice:

“In the beginning, I needed some time to understand the different buttons and functions of the platform. After practicing and using it in the sessions, I became more comfortable and could access the material more easily.” (PP02)

Caregiver-users were not required to operate the technology or provide their own devices or connectivity. They experienced the digital material through the family peer-providers and reported being able to follow the sessions without difficulty. A caregiver-user explained:

I did not need to use the phone myself. The provider showed us the videos and guided us through the session, so I could easily follow what was being discussed. (CU3)

Family peer-providers described some time demands associated with delivering the sessions and home visits, although the structured platform helped them manage the intervention:

It took some time to conduct the sessions and home visits, but having everything organized on the platform made it easier to manage the activities. (PP02)

CST trainers similarly noted that supporting providers required time, particularly for supervision, but the platform helped structure the process:

Supervision required time, but the platform made it easier to review what had been delivered and identify areas where the providers needed support.(CST-T01)

Self-efficacy

Family peer-providers reported that the structured workflows increased their confidence in conducting CST sessions. They valued being able to review the objectives, instructions and materials for each activity rather than relying solely on their memory of training. Access to videos and opportunities to revisit guidance were also perceived as helpful:

“The platform gave guidance for each activity, including the title, what we were supposed to achieve, and the instructions for how to conduct it. The videos and activity guidance were also available, and whenever we needed revision or guidance, we could get it, which increased our confidence in delivering the session.” (PP01)

Trainers reported that the platform supported continuity between training and intervention delivery. The ability to review previous content and prepare for upcoming sessions was considered useful in helping providers respond to individual caregiver concerns and manage group sessions.

These findings reflected perceived confidence rather than objectively assessed provider competence. Whether platform-supported guidance improves or maintains competence requires separate evaluation.

Perceived effectiveness

Participants perceived several platform features as supporting intervention delivery. Family peer-providers valued being able to locate and replay individual videos without repeating an entire section of the workflow. They also considered the platform useful across different delivery activities, including group discussions, practical demonstrations, individual planning during home visits and caregiver follow-up.

Caregiver-users considered video demonstrations particularly helpful because they provided concrete examples of strategies that were subsequently explained and discussed by the provider:

“The video helped me understand the strategy because I could see an example of what was being explained. After watching it, the discussion with the provider made the information easier to relate to my own child.” (CU03)

Caregivers also described applying CST strategies to everyday interactions with their children, including waiting after giving an instruction and providing reminders before transitions. These accounts indicate perceived usefulness and relevance; they do not establish changes in caregiver behaviour or child outcomes.

Ethicality and contextual relevance

Participants considered the content and delivery approach relevant to the local caregiving context. The use of familiar characters representing children with different developmental conditions, including Bablu with autism, Beena with cerebral palsy, and Bano with intellectual disability, helped participants relate the content to children and situations within their own families and communities. The materials also reflected the role of grandparents, joint-family relationships and wider social networks in caregiving. One caregiver-user explained:

The characters were like the children we see in our community. It helped us understand that these children also need support and that the family has an important role. (CU03)

The community-based delivery model was also viewed as appropriate. Family peer-providers were themselves mothers of children with neurodevelopmental delays and participated in the groups alongside other caregivers. Their shared experiences were perceived as helping create a sense of understanding and reducing feelings of being alone. As one caregiver-user described:

The provider is also a mother of a child with difficulties, so she understands what we are going through. When she shares her own experience in the group, we feel that we are not alone.(CU02)

Participants also valued the inclusion of situations related to school support and community involvement. These examples were perceived as encouraging families to discuss children's needs more openly and to involve grandparents and other family members in supporting the child. One participant noted:

When mothers talk together and share their experiences, families can understand the child better. It also helps us think about how grandparents, schools and other people in the community can support these children.(CU02)

Overall, the use of locally relevant family and community situations, together with delivery by family peer-providers with lived caregiving experience, was perceived as making TAP-CST more understandable, relatable and acceptable within the local context.

Acceptability of the wider implementation functions

Initial feedback on the training and session-delivery functions was positive. Providers and trainers valued the availability of training materials, structured delivery guidance and opportunities to review content. The screening, supervision, monitoring and referral functions were successfully incorporated into the prototype, but participants had more limited experience of using these functions over time.

Participants described the Ten Questions Screen [18, 19]as a useful starting point for identifying children who might benefit from CST. Providers also valued the availability of supervision through the platform, particularly for reviewing session delivery and addressing difficulties encountered during implementation. Monitoring functions supported the recording and review of delivery-related information, including session completion and provider-related issues. Referral decision support was

incorporated into the platform to guide providers when concerns requiring additional support or referral were identified. However, participants had limited experience with longer-term use of monitoring, outcome recording and referral functions, and therefore these findings were primarily based on their initial experience of the prototype.

Consequently, the study primarily established the acceptability of the training and delivery components. The acceptability and practical performance of supervision, longitudinal monitoring, outcome assessment and referral require evaluation during longer-term implementation.

Convergence, variation and areas for refinement

There was broad convergence across participant groups regarding the value of structured workflows and accessible video-based materials. Trainers emphasised fidelity to the planned session sequence and continuity between training and delivery. Family peer-providers focused on practical guidance and confidence during sessions, while caregiver-users emphasised clarity, concrete demonstrations and the relevance of strategies to their children.

Differences were most apparent in how participants encountered the technology. Trainers and family peer-providers interacted directly with TAP, whereas caregiver-users experienced it through provider-facilitated sessions. Familiarity also influenced providers' experiences: new users required time and practice, while those with previous TAP experience found the workflows easier to navigate.

The principal areas identified for refinement concerned video access and selection, forward and backward navigation, simplified button and icon labels, session sequencing, access to discussion points, the break function and dedicated notes functionality. Additional refinements addressed offline data handling and synchronisation, as well as video access under limited connectivity. Some participants initially experienced minor difficulties with navigation and familiarisation with the platform; however, these issues were addressed through iterative refinement and no major reservations were reported. No changes to the core CST content or delivery structure were required following field testing.

Overall, TAP-CST was viewed as an acceptable means of supporting family peer-provider delivery of CST. Its acceptability depended not on digitisation alone but on the integration of structured guidance, accessible intervention materials and provider-facilitated engagement within a single delivery workflow.

DISCUSSION

This study provides preliminary evidence that the Technology-Assisted Platform for Mental Health (TAP), originally developed for a psychological intervention for perinatal depression, can be reconfigured to support a substantially different psychosocial intervention [10]. WHO Caregiver Skills Training (CST) differs from the Thinking Healthy Programme in its target population, therapeutic content, provider competencies, delivery format, outcome measures and referral requirements. Nevertheless, CST was

accommodated within TAP while retaining both its core intervention components; nine group sessions and three home visits, and the platform's principal implementation functions: identification and screening, competency-based training, structured delivery and decision support, supervision, monitoring, and risk management and referral. Trainers, family peer-providers and caregiver-users viewed the resulting TAP-CST prototype as acceptable, useful and relevant to the rural context. These findings establish initial configurational feasibility and acceptability, although they do not yet demonstrate effectiveness or readiness for large-scale implementation.

TAP as reusable implementation infrastructure

The principal contribution of this study is not simply the digital presentation of CST materials. Many digital interventions reproduce therapeutic content electronically while leaving the systems required for implementation training, supervision, quality assurance, outcome monitoring and referral to be developed separately [22]. TAP instead separates intervention-specific content from a common implementation architecture. This allowed CST materials and workflows to be incorporated into an established platform without creating a new digital system for each function or intervention.

The successful configuration of both the Thinking Healthy Programme and CST within the same architecture provides preliminary support for this model. The two interventions address different conditions and populations and require distinct therapeutic processes. Their accommodation within a common platform therefore represents a meaningful early test of architectural reusability. However, reusability should not be interpreted as implying that interventions can be transferred into TAP without adaptation. Each intervention requires systematic mapping of its theory, core components, provider competencies, delivery processes, measures and referral pathways. TAP provides a common implementation structure within which this intervention-specific work can occur.

This streamlined configuration process was facilitated by the maturity of the CST intervention materials. The CST content was already fully developed and digitized, including the intervention manual, session materials, stories, videos and other supporting content [7] Consequently, the configuration process could focus primarily on mapping and adapting the existing content and delivery processes to the TAP architecture across the four configuration workshops. For interventions that are not yet digitized, an additional preparatory stage would be required to develop and digitize the intervention content before the TAP configuration process begins. Our work in adapting the Thinking Healthy Programme to the TAP architecture illustrates this process (ref Atif et al 2022). Following this stage, the subsequent process of internal testing, cognitive walkthrough, expert review, end-user usability testing and iterative refinement could be followed. Thus, the reusability of TAP does not imply a uniform number of configuration steps for every intervention; rather, the preparatory requirements may vary according to the maturity and format of the intervention being integrated.

A shared architecture could have wider relevance for mental health systems in low-resource settings. Digital programmes are frequently developed as separate, condition-specific products, potentially

duplicating investments in software, training systems, data collection and supervision [22]. A reusable platform may reduce this fragmentation and enable providers and supervisors to work within familiar workflows when delivering more than one intervention. This could be particularly valuable where a limited non-specialist workforce must respond to multiple mental health and developmental needs [23]. These potential efficiencies remain hypotheses, however, and require evaluation through comparative implementation and economic studies.

Why TAP-CST was acceptable

Acceptability appeared to arise from the way TAP supported intervention delivery, rather than from the presence of technology alone. Family peer-providers valued having session instructions, activities, videos and key messages organised in the easily accessible sequence and available at the point of delivery. This reduced reliance on recalling extensive material from training and gave providers a clear structure for conducting group sessions and home visits. Trainers similarly valued the continuity between provider preparation and subsequent delivery. These findings suggest that the platform may function as a practical bridge between training and routine practice, where competencies learned during initial training must be maintained and applied consistently.

The findings also reinforce the importance of retaining the human provider within technology-assisted care. TAP did not replace the family peer-provider or automate the caregiver intervention. Providers continued to explain content, demonstrate strategies, facilitate discussion and help caregivers apply CST principles to their own children. The technology supported these relational and interpretive functions by making relevant materials and guidance available when needed. Caregiver-users experienced the platform through the provider and therefore did not require their own device, internet access or digital literacy. This provider-carried model may help limit digital exclusion in communities where access to technology is uneven, although its effects on equitable reach should be examined empirically.

Participants particularly valued the combination of video demonstrations and provider-led discussion. Videos offered concrete examples of caregiver–child interaction strategies, while family peer-providers helped caregivers interpret and adapt these strategies to everyday challenges. This combination may be especially relevant for interventions involving complex behavioural and communication techniques, which can be difficult to convey through written materials alone. Nevertheless, this study assessed participants' perceptions of usefulness rather than whether the platform improved provider competence, intervention fidelity or caregiver outcomes.

Participatory configuration and contextual fit

The iterative participatory process was important to the development of the prototype. CST trainers, intervention specialists, technology developers and family peer-providers contributed different forms of expertise to mapping CST onto TAP. Simulated testing then identified practical problems involving navigation, access to videos and session flow before field use. This process illustrates that configuring

an intervention within an existing platform is not solely a technical exercise. It requires attention to intervention fidelity, provider workflows, user capabilities and the conditions under which delivery occurs.

The study setting also provided a relevant test of the approach. Rural communities in Pakistan face limited access to specialist developmental and child mental health services, alongside barriers related to geography, cost and stigma [6]. Previous research has demonstrated the feasibility of training family volunteers to deliver caregiver skills interventions in these settings [8]. TAP-CST could strengthen such community-based models by providing integrated support for training, structured delivery, supervision, monitoring and referral while preserving the central role of family peer-providers. It could also complement wider primary-care, non-governmental organisation and social-franchise delivery systems by linking community providers with supervisors and referral services. The feasibility of these system-level linkages was not fully examined in the present prototype study and should be evaluated during longer-term implementation.

Implications for implementation and scale-up

The findings suggest several priorities for subsequent evaluation. First, the platform should be assessed during complete cycles of provider recruitment, competency-based training, intervention delivery and supervision. Such evaluation should determine whether TAP supports the acquisition and maintenance of provider competence, adherence to CST core components and timely identification of providers requiring additional support. Second, monitoring and referral functions should be evaluated using real-world indicators, including data completeness, supervisor responsiveness, referral appropriateness and referral completion.

Third, future studies should examine reach, adoption and equity. A provider-carried platform may reduce barriers for caregivers without digital access, but device availability, connectivity, provider confidence and geographic dispersion may still affect implementation. Fourth, economic evaluation should establish whether reuse of a common platform genuinely reduces training, supervision and programme-management costs relative to intervention-specific systems. Finally, effectiveness studies are required to determine whether TAP-supported CST improves caregiver skills, caregiver well-being and child functioning and whether outcomes are comparable with established CST delivery.

Strengths and limitations

A strength of the study was its inclusion of perspectives from those responsible for configuring, training, delivering and receiving the intervention. The two-phase design enabled initial mapping and simulated testing to inform refinement before field evaluation. Use of the Theoretical Framework of Acceptability also provided a systematic basis for examining participants' experiences.

Several limitations should be considered. The study was conducted in one rural Union Council with a small, purposively selected sample, limiting transferability to other populations and health systems.

Participants had relatively brief exposure to a preliminary prototype, and their positive assessments may not reflect acceptability during sustained routine use. Some family peer-providers had previous experience with TAP, which may have increased their familiarity and confidence but may also have reduced the relevance of their usability assessments to new users. Conversely, this prior experience offers an initial indication of the potential value of maintaining familiar workflows across interventions.

Caregiver-users did not operate the platform directly; their accounts therefore concern the acceptability of TAP-supported CST delivery rather than the usability of the technology itself. Interviews may also have been affected by social desirability, particularly where participants had established relationships with providers or the implementing organisation. The study did not assess provider competence, fidelity, clinical outcomes, costs or comparative effectiveness. Moreover, although the full set of TAP implementation functions was configured, functions such as supervision, longitudinal monitoring and referral require evaluation over a substantially longer implementation period. The findings should therefore be interpreted as preliminary evidence of configuration feasibility and acceptability, not evidence of clinical effectiveness or scalability.

CONCLUSIONS

WHO CST could be configured within TAP while preserving its core content and delivery structure, and the preliminary prototype was acceptable to CST trainers, family peer-providers and caregiver-users in rural Pakistan. The findings extend TAP beyond its original application and provide early support for its potential as reusable implementation infrastructure for non-specialist-delivered psychosocial interventions. The value of this approach will ultimately depend on whether it can maintain provider competence and intervention quality, strengthen supervision and referral, improve equitable access and reduce implementation costs at scale. These questions should now be examined through larger and longer-term effectiveness and implementation studies.

ABBREVIATIONS

• **CST**
Caregiver Skills Training
• **ENACT**
Enhancing Assessment of Common Therapeutic Factors
• **HDRF**
Human Development Research Foundation
• **LMICs**
Low—and Middle—Income Countries
• **TAP**
Technology—Assisted Platform for Mental Health
• **TFA**
Theoretical Framework of Acceptability

• **THP**
Thinking Healthy Programme
• **WHO**
World Health Organization

DECLARATIONS

Ethics approval and consent to participate

The study received ethical approval from the Human Development Research Foundation (HDRF). The research was conducted in accordance with the applicable ethical guidelines and regulations. Written informed consent was obtained from all participants prior to their participation in the study.

Trial registration

Not applicable. This study was a formative acceptability study and did not involve a clinical trial.

Consent to participate

Written informed consent was obtained from all participants before their participation in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This study received no specific funding.

Author Contribution

HM contributed to the study conception and design, data collection, data analysis, and manuscript preparation. HN, MT, MH, AK, MK, and RL contributed to the study design, implementation, supervision, interpretation of findings, and critical review of the manuscript. AR contributed to study supervision, interpretation of findings, and critical review of the manuscript. All authors reviewed and approved the final manuscript.

Acknowledgement

The authors would like to thank all caregivers, family members, providers, and other stakeholders who participated in the study and generously shared their time and perspectives. We also acknowledge their valuable contributions to the configuration and refinement of the technology-assisted platform.

Data Availability

The datasets generated and/or analysed during the current study are not publicly available due to the sensitive nature of the study data but may be available from the corresponding author on reasonable request, subject to relevant ethical and institutional approvals.

REFERENCES

1. Olusanya BO, Davis AC, Wertlieb D, Boo NY, Nair MK, Halpern R, et al. Developmental disabilities among children younger than 5 years in 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Glob Health. 2018;6. 10.1016/S2214-109X(18)30309-7.
2. Alloh FT, Regmi P, Onche I, Van Teijlingen E, Trenoweth S. Mental health in low-and middle income countries (LMICs): going beyond the need for funding. Health Prospect: Journal of Public Health. 2018;17(1):12 – 7.
3. Salomone E, Pacione L, Shire SY, Brown FL, Reichow B, Servili C. Development of the WHO Caregiver Skills Training Program for developmental disorders or delays. Front Psychiatry. 2019;10:769. 10.3389/fpsyt.2019.00769.
4. Raina P, O'Donnell M, Rosenbaum P, Brehaut J, Walter SD, Russell D, Swinton M, Zhu B, Wood E. The health and well-being of caregivers of children with cerebral palsy. Pediatrics. 2005;115(6):e626–36.
5. Bliznashka L, Nwabuikwu O, Ahun MN, Becker K, Nnensa T, Roschnik N, et al. Understanding modifiable caregiver factors contributing to child development among young children in rural Malawi. Matern Child Nutr. 2024;20. 10.1111/mcn.13698.
6. Montiel-Nava C, Montenegro M, Ramirez AC, Villarreal V, Chacko LM, Dixon P, et al. Scoping review: facilitators, barriers, and cultural adaptations in the caregiver skills training program for children with developmental concerns. Autism. 2026;30:668–81. 10.1177/13623613251406399.
7. Hamdani SU, Huma ZE, Suleman N, Akhtar P, Nazir H, Masood A, et al. Effectiveness of a technology-assisted, family volunteers delivered, brief, multicomponent parents' skills training intervention for children with developmental disorders in rural Pakistan: a cluster randomized controlled trial. Int J Ment Health Syst. 2021;15. 10.1186/s13033-021-00476-w.
8. Jordans MJD, Kohrt BA. Scaling up mental health care and psychosocial support in low-resource settings: a roadmap to impact. Epidemiol Psychiatr Sci. 2020;29:e189. 10.1017/S2045796020001018.

9. Atif N, Nazir H, Sultan ZH, Rauf R, Waqas A, Malik A, Sikander S, Rahman A. Technology-assisted peer therapy: a new way of delivering evidence-based psychological interventions. BMC Health Serv Res. 2022;22:842. 10.1186/s12913-022-08233-6.
10. Rahman A, Malik A, Nazir H, Zaidi A, Nisar A, Waqas A, et al. Technology-assisted cognitive-behavioral therapy for perinatal depression delivered by lived-experience peers: a cluster-randomized noninferiority trial. Nat Med. 2025;31:2196–203. 10.1038/s41591-025-03655-1.
11. Atif N, Nazir H, Waqas A, Nisar A, Maryam H, Kanwal M et al. Technology-assisted platform (TAP) for training and supervision of task-shared psychosocial interventions to ensure competency during scale-up in low-resource settings. Camb Prisms Glob Ment Health. 2026;13.
12. World Health Organization. Caregiver skills training for families of children with developmental delays or disabilities: facilitators' guide: group sessions 1–9. Geneva: World Health Organization. 2022. ISBN 978-92-4-004893-5.
13. World Health Organization. Caregiver skills training for families of children with developmental delays or disabilities: home visit guide for facilitators. Geneva: World Health Organization. 2022. ISBN 978-92-4-004897-3.
14. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. BMC Health Serv Res. 2017;17(1):88.
15. Hamdani SU, Minhas FA, Iqbal Z, Rahman A. Model for service delivery for developmental disorders in low-income countries. Pediatrics. 2015;136(6):1166–72.
16. Goldsmith LJ. Using framework analysis in applied qualitative research. Qual Rep. 2021;26(6):2061.
17. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349–57. 10.1093/intqhc/mzm042.
18. Faruk T, King C, Muhit M, Islam MK, Jahan I, Baset K, et al. Screening tools for early identification of children with developmental delay in low- and middle-income countries: a systematic review. BMJ Open. 2020;10. 10.1136/bmjopen-2020-038182.
19. Mirza I, Mehmood T, Tareen A, Davidson L, Rahman A. Feasibility study on the use of the Ten Questions Screen by lady health workers to detect developmental disabilities in Pakistan. J Pak Psychiatr Soc. 2008;5(2):97–100.
20. Kohrt B, Jordans M, Rai S, Shrestha P, Luitel N, Ramaiya MK, et al. Therapist competence in global mental health: development of the Enhancing Assessment of Common Therapeutic Factors (ENACT) Rating Scale. Behav Res Ther. 2015;69:11–21. 10.1016/j.brat.2015.03.009.
21. Terp AM, Habashneh R, Brown FL, Abualhaija A, Aqel IS, Ghatasheh M, et al. Facilitators and barriers to participation and scale-up of a non-specialist delivered psychological intervention for adolescents in low-resourced settings: a process evaluation. BMC Public Health. 2025;25(1):725.
22. Alghadier M, Altheyab AS. The Digital Pediatric Physiotherapy Framework (DPPF): a systematic review of digital health integration in pediatric physiotherapy. Children. 2026;13(4):541.

23. Liu A, Sullivan S, Khan M, Sachs S, Singh P. Community health workers in global health: scale and scalability. Mt Sinai J Med. 2011;78(3):419–35.