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Barriers to and Facilitators of Engaging With and Adhering to Guided Internet-Based Interventions for Depression Prevention and Reduction of Pain-Related Disability in Green Professions: Mixed Methods Study

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Abstract

Background: Internet-based interventions (IBIs) are effective for the prevention and treatment of mental disorders and are valuable additions for improving routine care. However, the uptake of and adherence to IBIs are often limited. To increase the actual use of IBIs, it is important to identify factors for engaging with and adhering to IBIs.

Objective: We qualitatively evaluated barriers and facilitators regarding a portfolio of guided IBIs in green professions (farmers, gardeners, and foresters).

Methods: Interview participants were selected from 2 randomized controlled trials for either the prevention of depression (Prevention of Depression in Agriculturists [PROD-A]) or the reduction of pain interference (Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists [PACT-A]) in green professions. The intervention group in PROD-A (N=180) participated in an IBI program, receiving access to 1 of 6 symptom-tailored IBIs. The intervention group in PACT-A (N=44) received access to an IBI for chronic pain. Overall, 41 semistructured qualitative interviews were conducted and transcribed verbatim. Barriers and facilitators were identified via inductive qualitative content analysis, with 2 independent coders reaching almost perfect intercoder reliability (Cohen κ=0.92). A quantitative follow-up survey (30/41, 73%) was conducted to validate the results. Subgroup analyses were performed based on intervention characteristics.

Results: We identified 42 barriers and 26 facilitators, which we assigned to 4 superordinate categories related to the intervention (20 barriers; 17 facilitators), work (4 barriers; 1 facilitator), individual (13 barriers; 8 facilitators), and technical (5 barriers; 0 facilitators) aspects. Key barriers (identified by at least 50% of the interviewees) were *time-consuming work life* (29/40, 73%) and *time-consuming private life* (23/40, 58%). Similarly, the most frequently identified facilitators included *presence of motivation, curiosity, interest and perseverance* (30/40, 75%), *flexible time management at work* (25/40, 63%), and *support from family and friends* (20/40, 50%). Although agreement with barriers in the quantitative follow-up survey was rather low (mean 24%, SD 11%), agreement with facilitators was substantially higher (mean 80%, SD 13%). Differences in agreement rates were found particularly between intervention completers and noncompleters. Completers agreed significantly more often that perceived IBI success; being motivated, curious, interested, and perseverant; and having a persisting level of psychological strain have been

facilitating. Noncompleters agreed more often with experiencing the e-coach contact as insufficient and technical problems as hindering for intervention completion.

Conclusions: Based on these results, strategies such as customization of modules for more flexible and adaptive use; video chat options with the e-coach; options to facilitate social support by family, friends, or other participants; or using prompts to facilitate training completion can be derived. These approaches could be evaluated in further quantitative research designs in terms of their potential to enhance intervention use in this occupational group.

Trial Registration: German Clinical Trials Register DRKS00014000, https://tinyurl.com/3bukfr48; German Clinical Trials Register DRKS0001461, https://tinyurl.com/ebsn4sns

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KEYWORDS

internet-based intervention; depression; chronic pain; barriers and facilitators; qualitative research; uptake; adherence; farmers; gardeners; foresters

Introduction

Background

The effectiveness of internet-based interventions (IBIs) is well established for depression treatment [1,2] and prevention [3]. IBIs can also be applied to effectively reduce disease-related disability in chronic somatic conditions such as chronic pain [4-7]. Guided IBIs for the treatment of mental and somatic disorders based on cognitive behavioral therapy have even been shown to be equally effective as face-to-face therapy [8].

However, low treatment adherence can be a limiting factor for treatment effectiveness in IBIs [9,10]. In quantitative studies, various factors were found to be possible predictors of intervention adherence, including guidance [11], the use of persuasive design elements [12,13], or individual factors such as planning [14]. Thus, much research in recent years has focused on optimizing IBIs to facilitate intervention adherence in participants [11,15-17], and barriers to IBI use might vary depending on different intervention aspects such as guidance level, focus on specific symptoms, or type of intervention.

Furthermore, participant characteristics such as female sex [18,19] and higher age [10,18] were identified as potential predictors of higher intervention adherence, whereas results for other characteristics such as education level are inconsistent [18,19]. As intervention adherence seems to vary systematically with some participant characteristics, this might indicate different requirements for the intervention in accordance with target groups. Thus, identifying these specific requirements to address them in IBIs could be a promising approach.

Although qualitative insights into the relevant factors for the use of and adherence to IBIs are scarce for specific treatment indications such as reduction of pain interference in chronic pain or addressing specific health problems (eg, insomnia, anxiety, and diabetes) as a risk factor for the development of depression, some insights already exist regarding IBIs aimed at the prevention or treatment of depression. Qualitative studies on the use of IBIs for prevention of depression in the workplace, treatment of depression comorbid with cardiovascular risk factors, or stress reduction in the workplace with different levels of guidance, each identified on a personal level, barriers such as lack of time, high stress levels or competing priorities, and low motivation because of negative mood or anxiety [20-22]. At a program level, barriers regarding content complexity and redundancy, program functionality, and perceived dangers such as privacy of the IBI were mentioned in a depression-prevention context targeting workers who were at high risk for depression [22]. Furthermore, aspects such as lack of personalization, lack of perceiving the IBI as therapy, or lack of new learnings because of known content were described with regard to an unguided IBI for depression treatment without therapeutic support [21]. Therefore, there is still a research gap to bridge regarding the identification of barriers to the use of a portfolio of guided IBIs to specifically address different health complaints as risk factors for the development of depression or pain-associated disability.

Barriers to and facilitators for the use of IBIs might even vary depending on the population being targeted. In rural contexts, specifically, barriers to mental health seeking have been reported to be higher than barriers to physical health seeking [23]. Furthermore, stigma against depression and lower agreement about depression treatment have been shown to be more prominent in rural than in urban contexts [24]. At the same time, the use of IBIs might be more acceptable to rural than to urban populations, as some studies have reported that rural populations have a lower preference for face-to-face contact than urban populations and are especially appreciative of autonomy and confidentiality aspects of IBIs, as indicated by a systematic review [25].

In the rural context, farmers seem to be especially at risk for mental disorders such as depression because of diverse risk factors such as financial strain, dependency on weather conditions, government regulations, high work demands, or psychosocial difficulties [26-30]. Furthermore, the prevalence of musculoskeletal pain symptomology is higher in farmers than in nonfarmers because of physical strain in agricultural activities [31,32]. Thus, pain interference with work and everyday activities can be assumed to be an additional burden in this occupational group. Thus, a research gap exists in identifying barriers to and facilitators of IBI use in the occupational group of farmers who are at risk for depression or are burdened with chronic pain.

Guided IBIs have been investigated in the specific occupational group of green professions, including farmers, gardeners, and foresters, as part of the model project “With us in balance,”

initiated by a social insurance in Germany regarding their effectiveness in reducing depressive symptomology (Prevention of Depression in Agriculturists [PROD-A]; trial registration: DRKS00014000) and pain interference (Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists [PACT-A]; trial registration: DRKS00014619) in 2 separate randomized controlled trials (RCTs) [33,34]. The first effectiveness results of a tailored IBI program aimed at the prevention of depression by targeting various risk factors revealed low intervention adherence in this target group, with only 22.2% of the intervention group completing at least 80% of the intervention modules 9 weeks after randomization [35], 51.5% at 6-month and 55.6% of the intervention group at 12-month follow-up [36]. These results are low in comparison with an average completer rate of 67.5% in guided IBIs for depression treatment [37] as well as a completer rate of 74.3% in an RCT evaluating a guided IBI for depression prevention in adults with subthreshold depression, each for the completion of at least 80% of the respective IBI [38]. This indicates challenges in the use of IBIs in this occupational target group. Therefore, determinants of uptake and adherence in this specific target group need to be investigated to successfully implement IBIs as part of routine health care [39].

Objectives

To the best of our knowledge, there has been no research regarding barriers to and facilitators for the use of IBIs in the specific target group of green professions. In a first step of this mixed methods study, we aimed to uncover barriers to and facilitators for the uptake of and adherence to IBIs based on a qualitative content analysis of semistructured qualitative interviews conducted in this specific occupational group. In a second step, we contrasted agreement rates to the identified barriers and facilitators collected in a follow-up questionnaire with the number of mentions based on the qualitative interviews to validate the factors identified in the interview sample. In a third step, we exploratively investigated differences in agreement rates to the identified barriers and facilitators between groups with different treatment indications and in intervention completers versus noncompleters.

Methods

Study Setting and Design of the RCTs

Semistructured qualitative interviews were conducted as part of a mixed methods evaluation in the context of the 2 RCTs, PROD-A [33] and PACT-A [34]. Both RCTs are part of a preventive model project of the social health care insurance for farmers, gardeners, and foresters (Sozialversicherung für Landwirtschaft, Forsten und Gartenbau) in Germany called "*With us in balance*" and thus evaluate both the entire portfolio of IBIs provided to the target group of green professions. Both studies aimed to evaluate the clinical and cost-effectiveness of guided IBIs in green professions compared with enhanced treatment as usual. PROD-A evaluates a program of 6 IBIs for indicated prevention of depression in participants with at least subthreshold depression, whereas PACT-A evaluates an IBI for the reduction of pain-related disability in participants with chronic pain symptomology for a duration of at least 6 months. Participation was accessible to entrepreneurs, collaborating spouses, family members, and pensioners working in green professions aged ≥18 years with sufficient insurance status. Recruitment for both RCTs started in January 2018 using a combined recruitment strategy based on a joint web-based screening and was completed for PROD-A (N=360) in April 2019; for PACT-A, recruitment was prematurely terminated in July 2020 because of overall low recruitment success (N=89 instead of the planned N=256). Further details on the RCTs can be found in the corresponding study protocols [33,34].

Ethics Approval

Both trials were approved by the Ethics Committee of the University of Ulm and registered in the German Clinical Trials Registry (DRKS00014000 and DRKS0001461). Informed consent was provided by all participants in both RCTs.

The IBIs

PROD-A evaluated a tailored IBI program consisting of 6 different IBIs aimed at the prevention of depression or at risk factors for depression. The trainings were provided by an external service company (GET.ON Institute). The IBI program included the training *GET.ON Mood Enhancer*, aiming at depressive symptoms in general [40], as well as *GET.ON Mood Enhancer Diabetes* specifically for patients with comorbid diabetes [41]. Further trainings were *GET.ON Stress* focusing on issues with perceived stress [42], *GET.ON Recovery* for insomnia [43], *GET.ON Panic* focusing on panic and agoraphobic symptoms [44], and *GET.ON Be clever—drink less* thematizing problematic alcohol consumption [45]. PACT-A evaluated the training *GET.ON Chronic Pain* that focused on chronic pain symptomology [46] and aimed to improve pain-related disability based on acceptance and commitment therapy.

Participants in both intervention groups went through the following 3-step process: (1) participating in a psychodiagnostic web-based assessment to determine relevant symptom areas and risk factors, (2) having an initial contact with their assigned personal e-coach (trained and qualified psychologists, psychologists in training for psychotherapy, or trained psychotherapists) via telephone or internal messaging function, and (3) starting the training phase in the assigned IBI. For PROD-A participants, the initial contact was used for a shared decision-making process to choose the most suitable IBI, whereas PACT-A participants were directly assigned to GET.ON Chronic Pain.

All 7 IBIs contained 6 to 8 modules, with the recommendation to complete 1 module per week. The IBIs were guided by e-coaches, who gave feedback to participants on each completed module either via telephone or in written form on the intervention platform. The *training phase* was followed by a *consolidating phase*, in which participants could have short monthly contact with their e-coach for up to 12 months. IBIs were customized by the external service provider to the occupational group of green professions by adapting personas and examples to the agricultural context and including corresponding photo material. Further intervention details can

be found in the corresponding study protocols of PROD-A [33] and PACT-A [34].

Design of the Mixed Methods Study

A qualitative interview study was conducted with participants of the respective intervention arms of both RCTs, each of whom used 1 of the 7 guided IBIs. Recruitment and data collection of interview participants were either conducted by the study team of the Friedrich-Alexander-Universität (for PROD-A) or by the study team of the University of Ulm (for PACT-A). Additional informed consent was obtained from all interview participants. Semistructured interviews were conducted based on an interview guide addressing perceived barriers to and facilitators for the uptake of and adherence to the IBIs. The same interview guide was used for all participants, as the interview items were applicable to participants of both RCTs, and the qualitative data analysis was aimed at addressing the pooled transcripts from both RCTs. The interview questions were embedded in a broader interview guide addressing different topics pertaining to the use of the IBIs beforehand. The results are reported according to the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines [47], as detailed in Multimedia Appendix 1. A quantitative follow-up survey was conducted to validate the results of the qualitative interview study. Interview participants were invited to report whether they agreed with the identified barriers and facilitators. Finally, statistical comparisons between specific subgroups (ie, treatment indication and completer status) were made based on the quantitative agreement rates.

Recruitment and Data Collection Procedure

Recruitment for the qualitative interviews started in June 2019 (PACT-A) and August 2019 (PROD-A), as enrollment for both RCTs was either already completed or nearly completed (intervention groups—PROD-A: N=180; PACT-A: n=42 of overall n=44). Participants who had previously agreed to be contacted for further studies (PROD-A: n=161; PACT-A: n=39) received a standardized invitation letter via email. The recommended period for the completion of the assigned IBI had expired for all invited RCT participants at this point. Informed consent was received from 17% (27/161) of PROD-A participants and 49% (19/39) of PACT-A participants, and an appointment for the qualitative interview was scheduled.

Interview conduct was based on purposeful theoretical sampling [48], aiming to recruit an interview sample with maximum variation regarding participant characteristics, particularly sex, occupational role, completer status, and type of IBI received. Participants were defined as intervention completers if they had completed all available intervention modules in their respective IBI until the interview was conducted. Participants not reaching this criterion were categorized as noncompleters. The interviews were concluded after 41 interviews (PROD-A: N=22, PACT-A: N=19).

Interviews were conducted via telephone by 3 master's degree candidates (Manuela Gasde, Andrea Riedel, and Saskia Locker) based on an interview guide and supervised by researchers Johanna Freund and Lina Braun. Interviews were audio recorded and transcribed verbatim based on an extended manual detailing transcription rules [49]. Personal details were anonymized [50] and participants were referenced with their study ID numbers. PROD-A participants did not receive compensation, whereas PACT-A participants received an expense allowance of €20 (US $22) for participating in the interview. The interview participants were invited to a quantitative follow-up survey for the validation of the identified themes. Participation in the follow-up survey was not compensated.

Interview Guide

The interview items for answering the research question regarding relevant barriers and facilitators for the use of and adherence to IBIs were formulated by following the interview guide of a qualitative interview study conducted in a different application context [51]. The interview items were adapted to the context of IBIs and target groups and formulated using an inductive exploratory approach, aiming to generate broad and unconstrained information about possible barriers and facilitators for the use of IBIs in the specific target group of green professions. The chosen inductive exploratory approach was the most suitable one, as there is, to our knowledge, no theoretical framework describing barriers to and facilitators for the use of a tailored IBI portfolio in such a specific occupational target group. Furthermore, this approach allowed us to address different aspects regarding the broad portfolio of IBIs against the occupational context of green professions. The interview guide contained instructions for interview conduct and formulated 5 main items, each with subordinate items entailing prompts for specific aspects (called "memos"), follow-up questions for further elaboration (called "hang-on") as well as filter questions to guide and standardize interview conduct for specific cases. The interview guide is featured in Table 1.

Table 1. Interview items for evaluating barriers and facilitators for the use of and adherence to the internet-based interventions.

Item number	Interview item
1[a]	How would you rate the training offer overall? What do you think of the offer?
1.1[b]	To what extent was the internet-based training suitable for you and your needs?
1.2[b]	To what extent were there aspects of the internet-based training that were not suitable for you and your needs?
2[a]	What helped you to "stick with" the internet-based training?
2.1[c]	Were there certain aspects that made it easier for you to continuously participate in the internet-based training?
2.2[b]	What personal circumstances made it easier for you to participate in the internet-based training?
2.3[b]	What professional circumstances made it easier for you to participate in the internet-based training?
3[a,d]	If you have ever been unable to engage with the internet-based training: what prevented you from engaging with the training and its content?
3[a,e]	You dropped out of the internet-based training after lesson (add number). What prevented you from engaging with the training and its content?
3.1[c]	What else prevented you from engaging with the content of the internet-based training?
3.2[b]	Specifically, was there anything that bothered you about the guided internet-based training that made you not want to engage with it?
3.3[b]	What personal circumstances prevented you from participating in the internet-based training?
3.4[b]	What professional circumstances prevented you from participating in the internet-based training?
3.5[b,e]	You have just described various problems. What was the decisive reason that you dropped out of the training?
4[a]	You just described that in (paraphrase situation) it was difficult for you to engage with the internet-based training. What would have helped you engage with the internet-based training in that situations?
4.1[c]	What else helped you?
4.2[b]	What else could have helped you in the internet-based training itself?
4.3[b]	Was there anything in your personal environment that could have helped you or someone who could have supported you?
4.4[b]	What role do friends and family play in supporting you to participate in the training?
4.5[b]	What positive reactions do you remember?
4.6[b]	What negative reactions were there?
4.7[b]	Was there anything in your professional context that could have helped you or someone who could have supported you?
5[a]	Imagine you would participate in an internet-based training again. Imagine also that you could wish for an internet-based training that would be exactly suitable for your needs. What would the ideal internet-based training look like for you?
5.1[c]	How would the internet-based training need to be designed to make you feel that you are basically capable of doing the internet-based training regularly and stick with it until completion?
5.2[c]	How would your private and professional environment have to be organized to make you feel that you are basically capable of doing the internet-based training regularly and stick with it until completion?

[a]Main question.

[b]Memo.

[c]Hang-on.

[d]Filter question for completers.

[e]Filter question for noncompleters.

Data Analysis

Qualitative Analysis

Qualitative content analysis was conducted based on 40 verbatim interview transcripts from both RCTs, using inductive category development [52]. One transcript had been excluded beforehand because it could not be objectively verified based on data from the intervention platform that the IBI was actually started by the participant and the reliability of his statements was doubtful. The codes were derived from the raw material with regard to the research question, using the procedure described as follows:

1. The 40 transcripts were divided into 10 equal portions of material, consisting of 4 interviews in each portion. The selection of the transcripts was balanced for participant characteristics, predominantly for sex, occupational role, completer status, and treatment indication (ie, PROD-A and PACT-A).
2. The first 10% of the material was independently inspected by 2 coders (Sophie Pausch and Lea Beywl) who generated codes from the material based on the research question. The generated codes were discussed until both coders agreed on a preliminary code system. This preliminary code system was then complemented by code definitions and exemplary statements from the interviews. Then, the current code system was discussed and reflected upon in a consensus meeting between the coders and the supervisor (Lina Braun) to resolve questions, reach a consensus on differing viewpoints, and ensure that the coding was done in accordance with the research question. Subsequently, the code system was adapted by Sophie Pausch.
3. This iterative procedure was then repeated by including the next portion of 4 interviews in the raw material. Both coders independently reviewed and modified the preliminary code system based on the new material, taking into account the already coded material. The coders discussed their adaptations and agreed on a preliminary modified code system. This version of the code system was discussed once again in a consensus meeting with the supervisor Lina Braun and was modified according to the consensus reached. The iterative coding procedure was then continuously repeated by extending the coding material to the next 4 interviews in each coding pass.
4. After the seventh iteration (ie, after 28 of the 40 interviews were included in the coded material), the coding system was additionally reviewed in detail by Lina Braun to ensure a distinct code allocation and a differentiated abstraction level of the code system. Sophie Pausch included this feedback in the revised code system.
5. After the eighth coding pass with an additional 10% portion of interviews, with overall 32 interview transcripts being included in the iterative development of the code system, it was concluded that theoretical saturation had been reached, as no inherently new category was added.
6. Coding rules were parallel to the development of the code system (steps 2 to 5) continuously developed, discussed, and finalized in the consensus meetings.
7. On the basis of the finalized code system and coding rules, the complete material, that is, the 40 interview transcripts, were independently coded by 2 coders (Sophie Pausch and Lea Beywl) in 1 pass. As no necessity for further consensus meetings arose during the coding process, coder independence during the final coding process was maintained. The intercoder reliability was exceptionally high (Cohen κ=0.92) and can be classified as almost perfect [53] based on the Brennan-Prediger coefficient κ [54].
8. To ensure communicative validity [55] of the identified themes, we presented them to the interviewed participants after the completion of the data analysis in a web-based follow-up survey. The themes were presented based on definitions but without quotations, and participants were instructed to rate whether they agreed with the hindering and facilitating factors described.

Verbatim transcription and qualitative data analyses were conducted using the data analysis tool MAXQDA (version 2018.2; VERBI Software GmbH) [56].

Quantitative Analysis

For sociodemographic comparisons, 2-tailed *t* tests were conducted for continuous variables and Fisher exact tests were conducted for categorical variables. Furthermore, explorative subgroup analyses for completer status and treatment indication were conducted based on dummy-coded quantitative variables from the quantitative follow-up survey. Subgroup analysis based on Fisher exact test was conducted for each barrier and facilitator based on the frequency of agreement to each factor for each group in the quantitative follow-up survey. Fisher exact test was chosen because of its robustness in small sample sizes and its cell counts often being <5 [57]. For all analyses, 2-sided *P* values were reported with $P<.05$ being used for assuming statistical significance. Quantitative analyses were conducted using SPSS Statistics (version 26; IBM Corp) [58].

Results

Participant Characteristics

Participant characteristics were analyzed for the total interview sample of 41 interviewees as well as subgroups of completers and noncompleters, as detailed in Table 2. Intervention use was analyzed with a focus on representativeness in relation to the main trials, which is why the interview sample was assembled to include at least one participant per IBI. The intervention use of the interview participants was in line with the overall intervention use in the PROD-A RCT, with GET.ON Stress being the IBI assigned most often along with GET.ON Mood Enhancer and GET.ON Recovery [35,36]. The ratio of interview participants who completed all intervention modules (completers) until the time of the interview to participants who did not complete all intervention modules (noncompleters) was 3:2. By contrast, the ratio of completers to noncompleters until the 12-month follow-up in the main trials (ie, PROD-A and PACT-A) was approximately 1:1. Multimedia Appendix 2 displays participant characteristics of the interview subsamples of PROD-A and PACT-A along with the total intervention samples of both RCTs to show the degree of representativeness of the interview sample for the main studies.

Table 2. Comparison of the characteristics of completers and noncompleters of the interview sample (N=41).

	All interview participants	Completers[a] (n=24)	Noncompleters[b] (n=17)	*t* test (*df*)[c]	*P* value[d]
Sociodemographic characteristics					
Sex (male), n (%)	17 (41)	8 (33)	9 (53)	N/A[e]	.34
Age (years), mean (SD)	55.88 (7.86)	54.71 (8.36)	57.53 (6.99)	1.14 (39)	.26
In a partnership or married, n (%)	39 (95)	23 (96)	16 (94)	N/A	>.99
Education, n (%)					.67
Low	18 (44)	10 (42)	8 (47)	N/A	
Middle	13 (32)	9 (38)	4 (24)	N/A	
High	10 (24)	5 (21)	5 (29)	N/A	
Occupational role, n (%)					.91
Entrepreneur	16 (39)	9 (38)	7 (41)	N/A	
Contributing spouse	12 (29)	7 (29)	5 (29)	N/A	
Contributing family member	5 (12)	3 (13)	2 (12)	N/A	
Pensioner or spouse of pensioner	6 (15)	3 (13)	3 (18)	N/A	
Incapacitated for work	2 (5)	2 (8)	0 (0)	N/A	
Study affiliation, n (%)					.54
PROD-A[f]	22 (54)	14 (58)	8 (47)	N/A	
PACT-A[g]	19 (46)	10 (42)	9 (53)	N/A	
Type of internet-based intervention, n (%)					.58
GET.ON Mood Enhancer	5 (12)	2 (8)	3 (18)	N/A	
GET.ON Stress	11 (27)	7 (29)	4 (24)	N/A	
GET.ON Recovery	2 (5)	2 (8)	0 (0)	N/A	
GET.ON Panic	1 (2)	1 (4)	0 (0)	N/A	
GET.ON Be Clever—Drink Less	2 (5)	2 (8)	0 (0)	N/A	
GET.ON Mood Enhancer Diabetes	1 (2)	0 (0)	1 (6)	N/A	
GET.ON Chronic Pain	19 (46)	10 (42)	9 (53)	N/A	
Period between baseline and interview (months), n (%)					.11
<6	2 (5)	0 (0)	2 (12)	N/A	
6-12	14 (34)	7 (29)	7 (41)	N/A	
>12	25 (61)	17 (71)	8 (47)	N/A	

[a]Completers were defined as interview participants who completed all intervention modules until the time of the interview.

[b]Noncompleters were defined as interview participants who had not completed all intervention modules until the time of the interview.

[c]*t* test was used only for continuous variables.

[d]*P* value is based for continuous variables on a 2-tailed *t* test and for categorical variables on an exact Fisher test.

[e]N/A: not applicable.

[f]PROD-A: Prevention of Depression in Agriculturists.

[g]PACT-A: Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists.

Qualitative Findings

Qualitative analysis identified 42 barriers and 26 facilitators that were categorized into the following main categories: (1) *intervention-related factors*, with the subcategories *training content* (barriers: 7/42, 17%; facilitators: 6/26, 23%) and *training realization and design* (barriers: 13/42, 31%; facilitators: 11/26, 42%); (2) *work-related factors* (barriers: 4/42, 10%; facilitators: 1/26, 4%); (3) *individual-related factors* (barriers: 13/42, 31%; facilitators: 8/26, 31%); and (4) *technical-related factors* (barriers: 5/42, 12%; facilitators: 0/26, 0%).

Overall, 2 barriers (1) *time-consuming work life* (29/40, 73% of interviewees) and (2) *time-consuming private life* (23/40, 58%) as well as 3 facilitators, *flexible time management at work*

(25/40, 63%); *presence of motivation, curiosity, interest, and perseverance* (30/40, 75%); and *support from family and friends* (20/40, 50%), were mentioned by at least 50% (20/40) of the interviewed sample and thus identified as key themes. Most of the identified factors represent a broad range of different aspects that can hinder or improve the participation in an IBI. Furthermore, 55% (22/40) of barriers and 62% (16/26) of facilitators were mentioned by at least 10% (4/40) of the interviewees and thus are listed as major themes with definitions and exemplary statements in Tables 3-6. The remaining barriers (20/42, 48%) and facilitators (10/26, 38%) that were reported by <4 interviewees (<10%) are summarized in Multimedia Appendix 3 as we assumed these factors to be of less relevance to the target group. Of these, 15% (6/40) of barriers and 27% (7/26) of facilitators were addressed by only 1 interviewee each.

On an average, interviewees named 6 barriers (SD 2.8; range 2-14) and 5 facilitators (SD 2.7; range 1-10). Intervention completers (n=24) named on average 6 barriers (SD 2.9; range 2-14) compared with noncompleters (n=16) reporting on average 7 barriers (SD 2.5; range 2-12). This difference was not statistically significant (t_{38}=1.1; P=.27). Furthermore, intervention completers named on average 6 facilitators (SD 2.5; range 2-10), compared with noncompleters reporting on average 4 facilitators (SD 2.5; range 1-9). This difference was statistically significant (t_{38}=−2.4; P=.02).

Table 3. Major themes of the qualitative results for the intervention-related barriers and facilitators pertaining to internet-based intervention (IBI) content from participants' perspectives (mentioned by at least 4 participants; N=40).

Categories	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Intervention-related barriers, IBI content (n=5)[b]				
Unhelpful content	11 (28)	18	Participants perceived the IBI content as unhelpful, uninformative, and uninteresting.	"Well, there was one or the other exercise that...I liked less or where I had less interest in it...when there are several exercises, that there is always a favorite and there is one that you don't like so much." [Interview 26]
Impersonal or static content	10 (25)	23	The content of the IBI (eg, specific exercises and questions) was perceived to be static, as in not being tailored to the participant, not addressing personal problems not, or not providing the option to select or deselect topics.	"It's not very personal, it's a machine." [Interview 5]
Missing key topics or unappealing focus	5 (13)	11	Participants mentioned that key topics were missing (eg, IBI content on dealing with aging in the green professions and IBI content with movement and sports exercises) or that they found the focus of the IBI (eg, on psychological support) to be unappealing.	"For my needs, I'm telling you, I was concerned with chronic pain, not psychological support." [Interview 4]
Level of requirements being perceived as too high or low	5 (13)	8	The level of requirement was perceived as too low (eg, if IBI contents were already known before the start of the IBI) or too high (eg, if the person was severely ill).	"...I think it fit for mild cases who only feel overwhelmed now and then.... Whether it is fitting for someone who is on the verge of burnout, I dare to doubt that." [Interview 30]
Difficulty in identifying with exemplary personas	4 (10)	4	Participants reported difficulties in identifying with the exemplary personas described in the IBI modules.	"...In the first two lessons, there was always a reference to these people that you introduced. One of them was pushed by a bull.... Well, I don't know if I could be pulled down like that by such an accident...." [Interview 4]
Intervention-related facilitators, IBI content (n=4)[c]				
Helpful content	14 (35)	20	Participants perceived the content to be helpful, informative and interesting.	"I found, the information about the disease VERY helpful or, well. I found it informative and educational!" [Interview 29]
Engagement with one's problems	12 (30)	15	Participants found it helpful to reflect on themselves and their problems, to become aware of their problems, and to do something good for themselves.	"It just did me good to deal with myself again. That I, um...consciously do something for myself." [Interview 38]
E-coach support	6 (15)	9	Participants perceived the personal contact, the exchanges with the e-coach and the feedback from the e-coach as helpful.	"The contact with the e-coach helped. That you always get feedback, questions and...notice that the [incomprehensible] are appreciated, which you have done...." [Interview 34]
Perceiving the IBI as a further health care approach	5 (13)	7	Participants perceived the IBI as a new, eventually promising treatment option.	"I think it's a super great thing because you just don't get anywhere with other things and it's a good way to A) deal with the issue and B) deal with broader issues too." [Interview 13]

[a]Total number of excerpts, including multiple mentions from the same persons.

[b]Factors related to the IBI content (eg, specific exercises), that made it difficult to participate in the IBI.

[c]Factors related to the IBI content (eg, specific exercises), that made it easier to participate in the IBI.

Table 4. Major themes of the qualitative results for the intervention-related barriers and facilitators pertaining to internet-based intervention (IBI) realization and design from participants' perspectives (mentioned by at least 4 participants; N=40).

Categories	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Intervention-related barriers, IBI realization and design (n=6)[b]				
IBI modules being too long	16 (40)	28	The IBI modules and the time needed to complete them were perceived as too long, and shorter and more frequent IBI modules would have been preferred.	"Only the length was too much at once. It's better to have short lessons more often than to sit at them for an hour and even longer or two hours each time. That's too much in terms of length, yes,...in terms of required time." [Interview 11]
Limited or complicated access to IBI content	10 (25)	16	Participants perceived the access to the contents of the IBI as limited or complicated and reported not having been able to access specific contents directly (eg, access to already completed exercises, questions, and audio files).	"...which was a bit inconvenient that you then always had to go to the next page within a lesson. Especially in the post-processing, where I knew there was this one point. But I had to look through all these pages before I got to that point...." [Interview 23]
Insufficient personal e-coach contact	10 (25)	15	The e-coach contact was perceived as not personal enough because of little use of the feedback option via telephone or the lack of face-to-face conversations and the resulting anonymity. Participants expressed the wish for more personal conversations, explanations regarding the IBI, and overall more telephone contact.	"Maybe this, what do you call it, this anonymity.... Well, I'm not really in favor of this anonymity. I would have preferred a conversation with eye contact." [Interview 14]
Lack of flexibility regarding IBI use	8 (20)	14	Participants perceived IBI use as inflexible as they felt tied down to a specific place to work with the IBI because of writing and reading on the computer, the internet connection requirements, and needing to sit in the office for long periods.	"The high effort to surf around on the Internet and that I could only do it here in the office." [Interview 22]
Insufficient video and audio messages	6 (15)	7	The number of video and audio messages was perceived as limited or the content of the video and audio messages was perceived as unappealing.	"That there are more video or audio messages.... Just that I don't have to read it, yes?! That it would have been more like watching TV, then it would have been even better, you know?!" [Interview 31]
Too few reminder emails	4 (10)	5	Participants found there were too few prompts or reminder emails with requests to complete the IBI.	"Maybe I would have needed more hints. Well, not hints, but prompts. It is perhaps sometimes annoying when you are reminded again and again, but I think that would have been helpful for me...." [Interview 38]
Intervention-related facilitators, IBI realization and design (n=5)[c]				
Independency regarding time	13 (33)	22	Participants perceived the option to participate in the IBI modules with flexibility of time (eg, opportunity to take a break and to cache) as helpful.	"What was suitable was that you could do it whenever you wanted. That you weren't tied to certain times, I thought that was very good." [Interview 11]
Flexible options in terms of IBI content	7 (18)	7	Participants found the flexibility to omit different topics of each IBI module (eg, tasks) or additional information if not needed to be helpful.	"There were always elective options.... There was something about ruminating thoughts or something else, where you had the choice, do you want to have some information on that, or not. I liked that, to be able to say in advance 'No, I don't need that now....'" [Interview 34]
Reminder emails	5 (13)	6	The regular reminder emails with prompts to continue the IBI were perceived as helpful.	"...but these reminders after a certain time, that was already quite good." [Interview 6]
Appealing design and presentation	4 (10)	5	Participants perceived the design and presentation of the IBI as appealing.	"That it [the IBI] is very well presented, that practical, that it was very comprehensible." [Interview 38]

Categories	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Flexible IBI use from home	4 (10)	4	The option of flexibility to participate in the IBI modules from home and not needing to go to the city was perceived as helpful.	"And that's why I find online training so valuable.... I don't have to get in the car and drive half an hour into town to get to therapy or anywhere else, and I don't have to shower beforehand. If need be, I can sit there in my stable clothes and go back to the stable afterwards...." [Interview 28]

[a]Total number of excerpts, including multiple mentions from the same persons.

[b]Factors related to IBI realization and design (eg, composition, structure, and organization) that made it difficult to participate in the IBI.

[c]Factors related to IBI realization and design (eg, composition, structure, and organization) that made it easier to participate in the IBI.

Table 5. Major themes of the qualitative results for the work-related barriers and facilitators from participants' perspectives (mentioned by at least 4 participants; N=40).

Categories	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Work-related barriers (n=2)[b]				
Time-consuming work life	29 (73)	69	Participants experienced the tasks in everyday work life as time-intensive and inflexible because of weather influences, seasonal tasks, and work peaks and thus, as challenging for IBI[c] participation.	"So actually, only operational work that is...very time-intensive and can't be postponed...harvesting work or something like that, where you...say that HAS TO BE now. Now there is simply no time at all for three days." [Interview 34]
Lack of staff leading to high workload	4 (10)	5	The (unforeseen) shortage of staff was experienced as aggravating for the workload, and thus, as challenging for IBI participation.	"This is a very special case, we don't have an apprentice this year and so there's a lack of manpower at all corners and then there's the bad conscience again because the work doesn't get done." [Interview 17]
Work-related facilitators (n=1)[d]				
Flexible time management at work	25 (63)	34	Flexible time management at work (eg, because of self-employment, pension, lease of land, downsizing of the company, low workload, and season) made it easier to participate in the IBI.	"Yes, simply that you are self-employed, that you can arrange your work freely." [Interview 20]

[a]Total number of excerpts, including multiple mentions from the same persons.

[b]Factors related to the work life that made it difficult for the participants to take part in the internet-based intervention.

[c]IBI: internet-based intervention.

[d]Factors related to the work life that made it easier for the participants to take part in the internet-based intervention.

Table 6. Major themes of the qualitative results for the individual-related barriers and facilitators from participants' perspectives (mentioned by at least 4 participants; N=40).

Categories (barriers)	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Individual-related barriers (n=9)[b]				
Time-consuming private life	23 (58)	47	Participants perceived their private life as time-consuming because of household chores, hobbies, family, and friends, such that there was limited time available to work on the IBI[c].	"That I was so busy privately, that I had no head for it. Primarily I had to take care of others to keep that going and myself I had to put aside. That was the only reason." [Interview 38]
Lack of support from family and friends	17 (43)	32	Participants experienced family and friends (initially) as not being supportive, accepting, helpful, or motivating regarding their IBI participation.	"You know, now when I say I have an appointment with the family doctor, right?! To take blood. Then that's alright. The environment knows that this has to be done now. But if I then sit down at the computer for an hour or ninety minutes and do something like that, well! Then...this is so negatively valued." [Interview 31]
Limiting mental or cognitive factors	12 (30)	15	Limiting mental or cognitive factors (eg, exhaustion, tiredness, and difficulty in concentrating) were perceived as challenging.	"Either I was too tired or I had worked too much." [Interview 36]
Lack of possibility of retreating to reflect on the IBI	10 (25)	12	Participants reported the lack of the possibility of retreating to a private and quiet space to reflect on the IBI as challenging.	"Predominantly it was a problem of time or just that there was too much hustle and bustle, so that you couldn't really go back to it, or just actually hunkered down in a room where it was quiet." [Interview 13]
Lack of computer skills or technical affinity	8 (20)	9	The lack of computer skills or technical affinity or the dislike of technical devices were perceived as challenging.	"That is quite concretely that I don't really like to sit at the computer and don't like to or rather would like to get away from surfing the Internet." [Interview 29]
(Self-made) time or performance pressure	7 (18)	7	Participants experienced (self-made) time pressure or performance pressure (eg, regarding the IBI and regarding the job) as challenging.	"Yes, sometimes I didn't progress as fast as I wanted, so I probably put myself under a bit of pressure there, but that had nothing to do with the training, because it's the same for everyone...." [Interview 13]
Lack of perceived IBI success	6 (15)	12	Participants experienced no improvements because of the IBI (eg, no pain reduction or improvement in well-being) or reported that they did not consider the IBI to be promising for achieving improvements.	"...The decisive point was actually that...I thought that the training would be of no use to me..." [Interview 39]
Lack of motivation	6 (15)	6	Participants reported experiencing a lack of motivation or such a low level of psychological strain, that there was no motivation to work with the IBI.	"...Sometimes you're just not motivated, let's say you don't feel like it or want to do something else, that you don't always want to deal with it. Yes, but then that's a sign that you're doing so well, that the pressure of psychological strain is no longer there...." [Interview 21]
Limiting somatic factors	4 (10)	6	Somatic factors (eg, chronic physical pain and pain caused by sitting for a long time) made it difficult to take part in the IBI.	"Yeah, because I'm in such massive pain and the painkillers didn't work and then you can't concentrate, not when there are so many, SO many questions that are actually always the same." [Interview 11]
Individual-related facilitators (n=6)[d]				
Presence of motivation, curiosity, interest, and perseverance	30 (75)	39	Participants reported experiencing motivation, curiosity, and interest relating to the next modules or the feedback from the e-coach or referred to their own attitude to follow through on something that they started.	"Curiosity about the next lesson. And also, curiosity about the feedback from the e-coach." [Interview 29]

Categories (barriers)	Participants		Definition	Supporting quotations
	Values, n (%)	Number of excerpts[a]		
Support from family and friends	20 (50)	46	The participants perceived support and acceptance from family and friends (eg, regarding the IBI use and regarding private and work life) as helpful.	"The family that has accepted everything and also notices, when you feel better or that you're not so, let's say, dissatisfied or whining, let's say, so in that respect it's already good now." [Interview 15]
Perceived IBI success	19 (48)	34	Participants reported that it was helpful to observe improvements in everyday life, or to at least have the hope for success (eg, reduction of pain and improvement of well-being).	"The results I have felt for myself in my everyday life." [Interview 22]
Flexible time management in private life	17 (43)	22	Flexible time management in private life (eg, because of living alone) was perceived as helpful.	"Yes, maybe...that the children are simply already more grown up. Well with small children, who then scream all the time, I don't think that would have worked." [Interview 20]
Scheduling of fixed time slots for the IBI	6 (15)	6	The scheduling of fixed time slots (eg, midday) for the IBI was perceived as helpful.	"Yes, I think it's better if you just set certain...times, that you say, Monday evening at 8 or 9 pm I will do now one lesson" [Interview 20]
Possibility of retreating to reflect on the IBI	4 (10)	5	Participants reported the possibility of retreating to a private and quiet space to reflect on the IBI as helpful.	"...That I have my quiet, closed computer workplace. Where I have a place of retreat, so to speak, which is otherwise a workplace, but that I have used for this...." [Interview 21]

[a]Total number of excerpts, including multiple mentions from the same persons.

[b]Factors related to the private life or personal factors that made it difficult for the participants to take part in the internet-based intervention.

[c]IBI: internet-based intervention.

[d]Factors related to the private life or personal factors that made it easier for the participants to take part in the internet-based intervention.

Quantitative Follow-up Survey

In total, 73% (30/41) of the interview participants responded to the quantitative follow-up survey and rated whether they agreed with the barriers and facilitators that we had extracted from the interviews. Overall agreement with the identified barriers was relatively low, with a mean of 24% (SD 11%; range 7%-47%). At least 40% (12/30) of the participants agreed that the barriers (1) *extensive questioning*, (2) *missing key topics or unappealing focus*, (3) *IBI modules being too long*, (4) *the wish for continuing possibility to participate in follow-up modules or IBIs*, and (5) *lack of a platform for exchanges with other participants* hindered their participation in the IBI.

However, the agreement with the identified facilitators was very high, with a mean of 80% (SD, 13%; range 53%-97%). At least 90% (27/30) of the participants agreed that the factors (1) *possibility of working independently on the IBI modules*, (2) *independence regarding time*, (3) *flexible IBI use from home*, (4) *free-of-charge treatment offer*, (5) *appealing IBI structure and composition*, (6) *optimal organization*, and (7) *comprehensible wording* facilitated their participation in the IBI.

Overall, the agreement rates for most of the identified barriers (32/42, 76%) and for all the facilitators were higher than the proportion of participants mentioning these in the interviews. Indeed, 27% (7/26) of facilitators that were mentioned by a single interview participant attained high agreement rates ranging between 60% (18/30) and 97% (29/30) in the follow-up survey. Figures 1-3 show the agreement rates in the quantitative follow-up survey for the barriers and facilitators compared with the number of participants mentioning these factors in the interviews.

Figure 1. Comparison of quantitative and qualitative results regarding intervention- and work-related barriers. IBI: internet-based intervention.

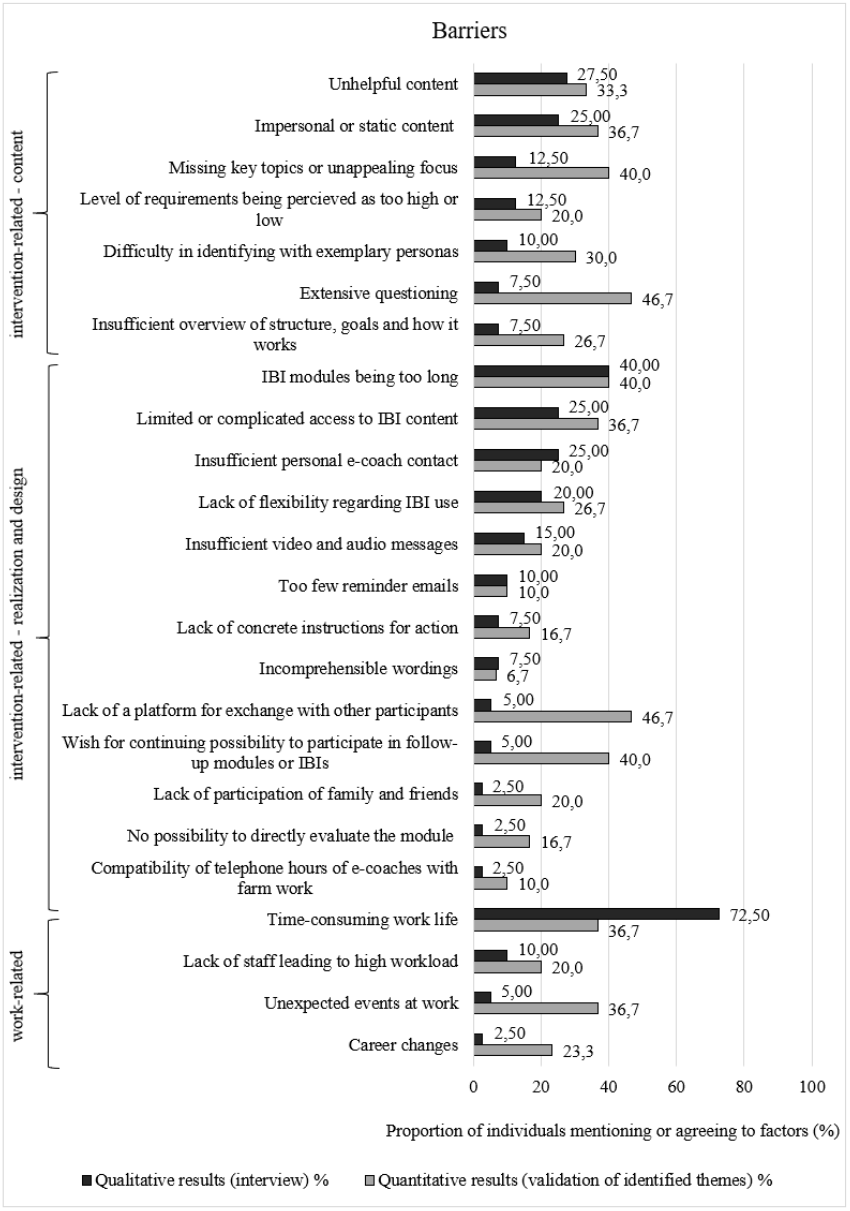


Figure 2. Comparison of quantitative and qualitative results regarding individual- and technical-related barriers. IBI: internet-based intervention.

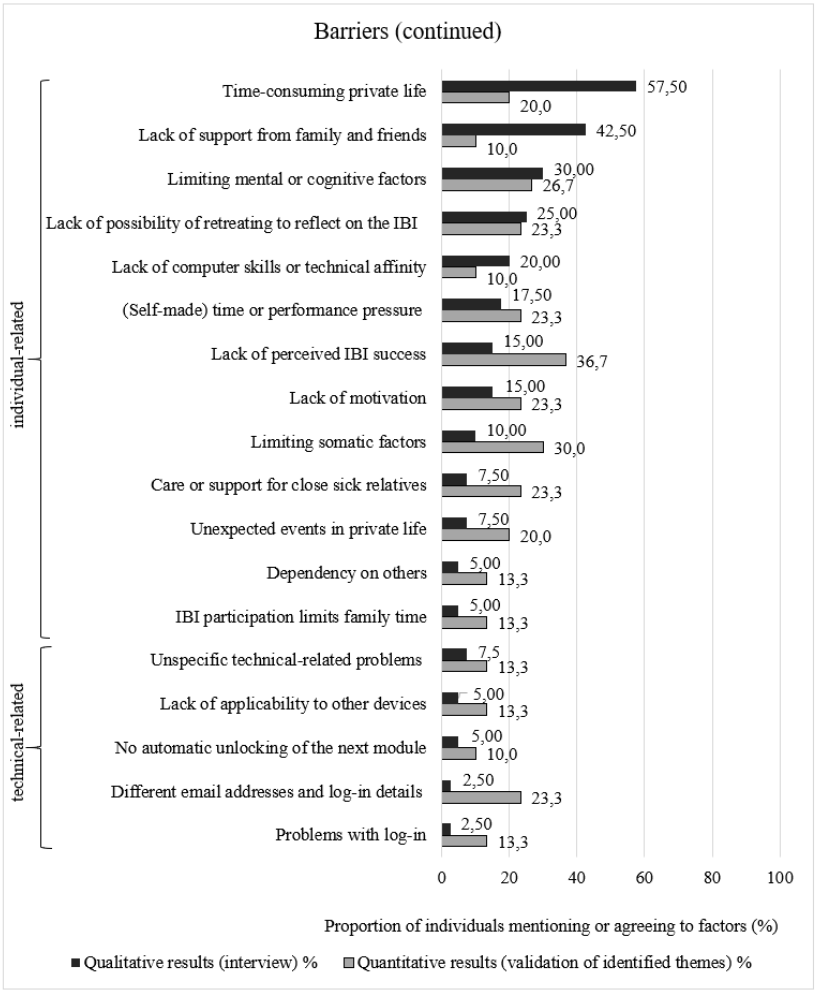
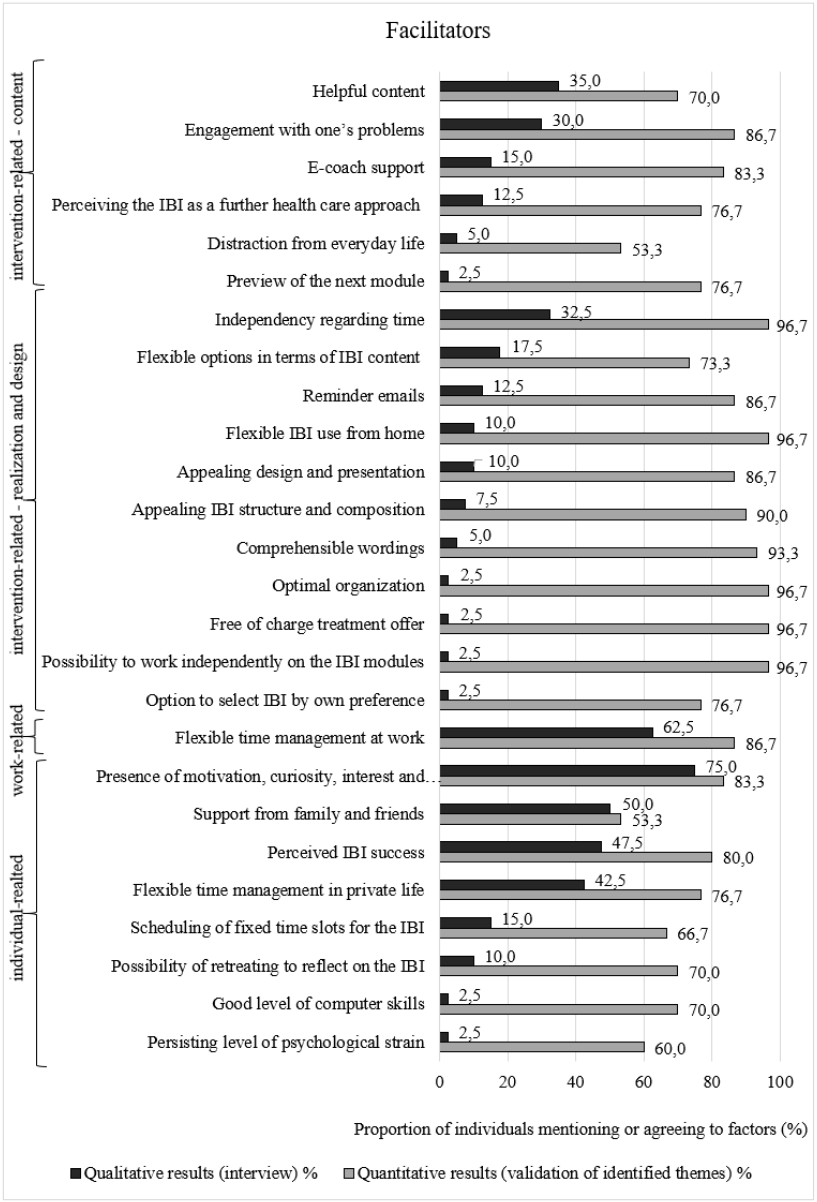


Figure 3. Comparison of quantitative and qualitative results regarding intervention-, work-, and individual-related facilitators. IBI: internet-based intervention.

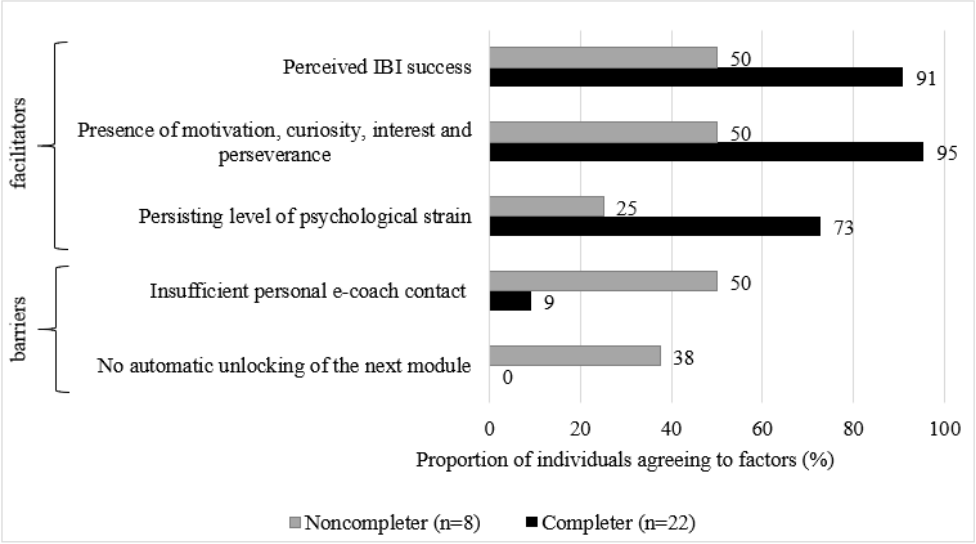


Subgroup Analysis Based on Quantitative Follow-up Survey

Subgroup Analysis for Completers and Noncompleters

A number of significant differences in agreement with relevant barriers and facilitators were found based on survey data, depending on the completer status. Noncompleters (8/30, 27%) reported agreement with the barrier *insufficient personal e-coach contact* (4/8, 50% vs 2/22, 9%; *P*=.03) and the technical-related barrier *no automatic unlocking of the next module* (3/8, 38% vs 0/22, 0%; *P*=.01) more often than completers (22/30, 73%). Completers reported agreement with the following factors as facilitating for training use significantly more often than noncompleters: having *perceived IBI success* or hope for IBI success (20/22, 91% vs 4/8, 50%; *P*=.03); having a personal attitude characterized by the *presence of motivation, curiosity, interest, and perseverance* with regard to training use (21/22, 95% vs 4/8, 50%; *P*=.01); and having a *persisting level of psychological strain* (16/22, 73% vs 2/8, 25%; *P*=.03). Figure 4 shows the relevant barriers and facilitators for completers versus noncompleters.

Figure 4. Significant group differences in perceived barriers and facilitators based on completer status in the quantitative follow-up survey (%). IBI: internet-based intervention.



Subgroup Analysis for Different Treatment Indications

On the basis of a comparison of the different treatment indications leading to study inclusion, interviewees who received a pain-specific IBI (14/30, 47%), as indicated by their chronic pain symptomology (ie, PACT-A), agreed with having technical difficulties more often than interviewees who received a symptom-oriented tailored IBI (16/30, 53%) because of being at risk for depression (ie, PROD-A). This was specifically indicated by the barriers *dependency on others* regarding training use (4/14, 29% vs 0/16, 0%; *P*=.04), *problems with log-in* (4/14, 29% vs 0/16, 0%; *P*=.04), and *different email addresses and log-in details* (6/14, 43% vs 1/16, 6%; *P*=.03). Furthermore, *perceived IBI success* (16/16, 100% vs 8/14, 57%; *P*=.005) as facilitator was reported more often by interviewees who received a symptom-oriented tailored IBI for depression than by interviewees who received a pain-specific IBI. In addition, interviewees who received the pain-specific IBI agreed less often with *e-coach support* being facilitating (9/14, 64% vs 16/16, 100%; *P*=.01) for training use. Significant differences in agreement rates to barriers and facilitators among interviewees with different treatment indications are shown in Multimedia Appendix 4. Descriptive statistics and Fisher exact test results for all comparisons can be found in Multimedia Appendix 5.

Discussion

Principal Findings

To the best of our knowledge, this is the first study to investigate barriers and facilitators for the use of and adherence to IBIs among interviewees working in green professions. Using qualitative content analysis, we were able to identify a wide range of possible barriers and facilitators with regard to a tailored intervention approach taking into account 7 different symptom-specific IBIs and risk profiles for depression and pain interference. Overall, 42 barriers and 26 facilitators were identified across 4 superordinate categories relating to interventional, work-related, individual, or technical aspects. Insights were reached regarding the comparison of barriers and facilitators perceived in completers and noncompleters in particular.

Comparison With Prior Work

Qualitative content analysis suggested that time restrictions in work and private life were elementary barriers from the interviewees' perspective. This is consistent with a systematic review (3 qualitative and 3 quantitative studies) describing lack of time as a key barrier to adherence to IBIs for various psychological conditions (eg, coping with tinnitus, bipolar disorder, and unipolar depression) and target groups (eg, carers of persons with cancer and persons affected by disasters) [19]. Furthermore, lack of time was identified in different workplace settings as a barrier with regard to an internet intervention for stress management supported by optional guidance [20] as well as for the use of an internet-based depression prevention program with participants who were at risk for major depression [22]. As interviewees strongly agreed with barriers, such as extensive questioning and IBI modules being too long, this reflects the apparently high burden for some participants; thus, IBIs might require adjustments against the background of time restrictions in work and private life. The incompatibility of the time-consuming processing of extensive text contents with the personal situation of the participant was previously described as a potential factor for nonadherence in a qualitative study of nonadherers of an internet-based psychological treatment [59].

Nonetheless, a previous study reported that the use of IBIs seems to be associated with fewer barriers such as time constraints than participation in face-to-face treatment [60]. In farming populations, work life can be especially time-consuming depending on the season, which negatively affects the capacity for mental health help seeking [61,62]. Thus, technology-based alternatives have been suggested as low-threshold alternatives to facilitate mental health help seeking in farmers [63] and in rural areas [64]. Indeed, some interviewees reported flexible IBI use from home or flexibility in terms of time as helpful for IBI use, as well as the possibility of working independently on the IBI modules. These facilitators, as well as flexible options

in terms of IBI content and IBI selection based on one's own preference, found exceptionally high approval in the follow-up survey. Furthermore, barriers, such as limited or complicated access to training content, the option to repeat individual training units, missing key topics, or unappealing focus, which have received high approval ratings, reflect the need for more flexibility regarding training length and content in the interview sample. This indicates the importance of autonomy of the participants in their training conduct, which was identified as an important factor for adherence to an internet-based depression treatment in a blended care setting in a previous qualitative study [65]. It might also be related to the need for a sense of control by being able to complete the IBI flexibly and to return as often as necessary, as reported in a qualitative study of completers of an internet-based depression treatment [21] and is also relatable from the perspective of therapists reporting limited customizability and individualization of IBIs to be a barrier in blended therapy for depression [66].

Furthermore, interviewees emphasized flexible time management at work as a key facilitator, highlighting a new aspect that, to our knowledge, has not been previously identified. Flexibility of intervention use has been reported as both a facilitating and a hindering factor in a workplace setting if prioritization of time fails or temporal and spatial boundaries between work and treatment get blurred [20]. As we interviewed entrepreneurs, contributing spouses and family members, or pensioners working in their own business, this facilitator might have a specific meaning for self- or family-employed persons in this occupational target group.

Moreover, perceived support from family and friends was suggested by interviewees as a key facilitator. This factor has been described previously in terms of sense of belonging being a motivating aspect for continuing a depression treatment in a blended-therapy setting [65]. In traditional farming, family relationships play an important role, as farming families live and work together on joint premises [27]. Accompaniment by family has been shown to substantially increase health care use in farm workers [67], underlining the importance of family support against the background of lower use of professional help regarding mental health problems among farmers compared with nonfarmers [68]. Thus, involving the entire farming family in an IBI might be beneficial for increasing adherence, specifically in this occupational group. This would be in line with a different health care initiative already targeting the entire farming family [69] and with the statement of the interviewees that they missed exchanges with other IBI participants, which, to our knowledge, was identified for the first time in IBI research. Nevertheless, this seems to be in line with data from male farmers who reported seeking informal support from close confidants for self-help [70]. However, as some participants reported lack of support from family and friends, involving the farming family or close friends may not be indicated in every case and might also be a potential stressor.

Interviewees suggested the presence of motivation, curiosity, interest, and perseverance in using the IBI as another key facilitator for intervention completion. Similarly, interest in an IBI and willingness, and motivation to participate in it have previously been identified as facilitating factors by psychotherapists in a blended depression treatment [66]. Motivational and volitional aspects have been proposed as prerequisites for the uptake of and adherence to IBIs based on the Health Action Process Approach model that describes their central role in health behavior change [71]. So far, a systematic review based on qualitative data found mixed results regarding motivation and readiness to change as potential predictors of intervention adherence [19].

Against the background of low overall adherence rates in green professions for the IBIs in question [35,36] as an example of the actual use of IBIs in a pragmatic setting, a comparison of intervention completers and noncompleters regarding their agreement rates to the identified barriers and facilitators was conducted. The comparison analysis revealed that completers agreed significantly more often with the aspect of hope for or perceived training success. In the literature, this factor has already been described as noticing an improvement [21] or having hope of recovery [65] as facilitating persistence with the intervention. The affirmed motivational aspects in completers are in line with the previously discussed theoretical assumption that motivational factors such as interest and willingness to persist seem likely to drive adherence to IBI. Regarding the noncompleters, they agreed significantly more often that the e-coach contact was not personal enough. This mirrors the importance of the role of a stable therapeutic relationship in training adherence, as shown in previous qualitative studies [20,21,65,72]. A qualitative interview study with Australian farmers, their partners, and general practitioners suggested that a good relationship with health care professionals might be critical for the uptake of and adherence to treatment protocols and that for this to happen, it may be crucial that health professionals are agriculturally literate and able to personalize farmers' care through practical advice [63]. This has also been described as the lack of "farm credibility" of service providers being a barrier for the use of mental health services in farmers [62]. As IBIs were already adapted in an initial step in terms of content and design to the agricultural setting, further steps might comprise more participant inclusion in further adaptation of intervention design and content, as already practiced in an Australian IBI for farmers conveying mental health and well-being strategies based on acceptance and commitment therapy [73], or the offering of special training courses for e-coaches working in this occupational setting to improve "farm credibility."

In addition, we compared interviewees included in the main trial because of chronic pain (ie, PACT-A) with interviewees included in the main trial because of psychological complaints indicating depression risk (ie, PROD-A) in terms of their perceived barriers to and facilitators for the use of their indicated IBI to determine potential differences. Interviewees included because of chronic pain agreed to experiences of training success or e-coach support being helpful less often than interviewees included because of being at risk for depression. As the presence of chronic pain symptoms is the main difference between these 2 interviewed groups, known factors such as high treatment resistance and long-term chronic pain symptomology [74] might be a possible explanation. Furthermore, a comparison of agreement rates in the follow-up survey suggested that

interviewees included because of chronic pain reported technical difficulties and dependency on others as barriers for training use more often. This might be associated with the significantly higher average age of interviewees in PACT-A compared with PROD-A, as previous research has already shown that digital literacy tends to be higher in younger age groups [75]. Similarly, low digital literacy along with poor connectivity in rural areas was identified as a barrier to the use of IBIs among Australian farmers based on an interview study [63]. Overall, the interview results suggest that digital literacy may be restricted to some of the interviewees at hand. To our knowledge, no research exists pertaining to the extent of digital literacy in persons occupied in green professions in Germany in general, despite the face validity of the assumption that digital literacy might be lower in the green sector than in the general population. This would be in line with a recent article suggesting that digital literacy may be lower in rural areas than in urban areas [76]. At least a few years ago, limited internet literacy and access were reported as being among the most important barriers to the implementation of IBIs for depression in routine care expected from the perspective of different stakeholders across 8 European countries [77]. Lack of internet access and computers along with a lack of familiarity with technology, internet, and media were reported as barriers from the perspective of an interview sample of general practitioners [78] as well as low technical affinity from the perspective of an interview sample of therapists, both with regard to the use of blended internet-based therapy for patients with depression in general [66]. Thus, improving access to high-speed internet in rural or remote areas along with the promotion of digital literacy in general might be helpful measures to break down barriers in the use of health care technologies in green professions.

Limitations and Strengths

This mixed methods study has several limitations. First, the interview sample was not representative of the population of green professions. We aimed to recruit a heterogeneous interview sample taking into account sex, occupational role, IBI type, and completer status to achieve the best representativeness possible. However, the self-selection of the participants regarding interview and survey participation was evident, as the sample of noncompleters was reduced from 41% (17/41) in the interview sample to 27% (8/30) in the follow-up survey. Thus, there is a noticeable underrepresentation of noncompleters in both RCTs, where approximately every second intervention participant at the 12-month follow-up did not complete the intervention (PROD-A: 85/171, 50%; PACT-A: 23/42, 55%). Overall, this might have led to a bias regarding the results of qualitative data analysis in favor of possibly fewer reported barriers. Furthermore, this might have favored an overestimation of the approval rates regarding the identified facilitators in the follow-up survey. Indeed, the approval rates of the identified facilitators were higher than those of the identified barriers, even though considerably more barriers than facilitators were identified overall. Second, the subgroup analyses performed were of purely explorative character, as there were no a priori hypotheses defined, there was no power calculation conducted beforehand, and the sample size of 30 was very small with regard to quantitative analyses. Thus, these subgroup analyses merely provide an opportunity to gain an idea of possible factors influencing the engagement with and adherence to IBIs in this specific occupational group. Further studies need to be conducted based on a priori power calculations to systematically investigate the identified barriers and facilitators as predictors of engaging with and adhering to IBIs. Third, there is possibly a bias because of the inclusion of interviewees from 2 different study populations with different treatment indications, and thus, a bias because of the overrepresentation of interviewees who received GET.ON Chronic Pain compared with those who received other IBI types. This might have facilitated a stronger focus on barriers and facilitators specific to the use of this IBI experienced by participants with chronic pain symptoms in comparison with those at risk for depression. Therefore, we carried out a comparative analysis of these 2 subpopulations to unravel and highlight potential differences in perceived barriers to and facilitators for the use of their corresponding IBIs because of different treatment indications and underlying symptoms of primarily somatic versus mental nature.

This study has also several strengths. First, the coded interview material was exceptionally extensive, consisting of 40 interviews overall, and thus, allowed for a comprehensive identification of possible barriers and facilitators. Second, the purposeful sampling procedure and the resulting heterogeneity of the interview sample enabled us to identify a wide range of barriers and facilitators of potential relevance. Owing to increased recruitment efforts, the perspective of noncompleters, in particular, could be taken into account. This may have resulted in the identification of substantially more barriers than facilitators, based on the qualitative interviews. Against the background of limited intervention adherence experienced in this occupational group [35,36], these results provide first insights into possible obstacles and enable to derive implications for facilitating intervention adherence. Third, the intercoder reliability was exceptionally high, reflecting the high methodological standards of the qualitative coding procedure. Fourth, by using a mixed methods approach, we were able to conduct explorative quantitative comparisons among different subgroups to evaluate possible divergences in the identified barriers and facilitators depending on completer status or treatment indication. Thus, this approach enabled us to achieve a more differentiated view of barriers and facilitators for training use and an idea about the possible relevance of individual factors.

Conclusions

Different implications for promoting green profession workers' engagement with and adherence to IBIs are imaginable based on the findings of this study. On the basis of the insights on the facilitators, we can conclude that the following factors pertaining to the IBIs worked particularly well from the perspective of the interview sample: (1) flexible use independent of time and location, (2) flexible options in terms of IBI content, (3) appealing design and presentation, (4) appealing structure and composition, (5) optimal organization, (6) overall helpful content, and (7) support of the e-coach. We derived the following options to further improve the use of IBIs in the occupational group of green professions based on insights into

the identified barriers: the implementation of (1) supportive strategies like the scheduling of fixed time slots for the IBI or tools such as push messages to facilitate training completion; (2) options to involve the entire farming family or friends and colleagues and to enable exchanges between participants, for example, via implementation of a forum, chat functions, or even group sessions with the e-coach; or (3) enabling face-to-face interaction with the e-coach via video chat on demand. Further ideas encompass (4) the customization of intervention modules in terms of intervention content and length to allow for more flexible and adaptive use or (5) the introduction of the option to flexibly access and repeat specific content. Thus, in future studies, these factors should be compared with existing theoretical frameworks and then jointly investigated using quantitative study designs and methods in terms of their ability to improve intervention uptake and adherence in the specific target group of green professions.

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Authors' Contributions

DDE and HB obtained funding for this study. LB developed the study design and the interview guide for the evaluation of barriers and facilitators and was responsible for the recruitment of interview participants from Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists (PACT-A), the coordination of the interview conduct, and the collection of interview data for PACT-A participants. JF and JT were responsible for the recruitment of interview participants from Prevention of Depression in Agriculturists (PROD-A), the coordination of the interview conduct, and the collection of interview data for PROD-A participants. LB was responsible for the evaluation method and the development of the code system and also supervised and contributed to qualitative data analysis and interpretation, performed the quantitative analysis, and drafted the manuscript. IT supervised the design and conduct of the qualitative interview study and the further writing of the manuscript. IT, HB, DDE, JF, and JT critically revised the article and approved the final manuscript.

Conflicts of Interest

IT reports having received fees for lectures and workshops in an e–mental health context from training institutes for psychotherapists. She was the research and implementation project lead of the trial site, Institute for Health Training Online (GET.ON), for the European implementation research project ImpleMentAll (November 2017 to March 2021), funded by the European Commission. HB reports receiving consultancy fees and fees for lectures and workshops from chambers of psychotherapists and training institutes for psychotherapists in an e–mental health context. DDE reports receiving consultancy fees and serving on the scientific advisory board for several companies, such as Minddistrict, Lantern, Novartis, Sanofi, Schoen Kliniken, IdeaMed, German health insurance companies (BARMER and Techniker Krankenkasse), and a number of federal chambers for psychotherapy. He is a stakeholder at the Institute for Health Training Online (GET.ON), which aims to implement scientific findings related to digital health interventions in routine care.

Multimedia Appendix 1
COREQ (Consolidated Criteria for Reporting Qualitative Research) checklist.
[DOCX File , 39 KB - mental_v9i11e39122_app1.docx]

Multimedia Appendix 2
Comparison of participant characteristics of the interview subsamples in terms of study affiliation and intervention arms of the randomized controlled trials Prevention of Depression in Agriculturists (PROD-A) and Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists (PACT-A).
[DOCX File , 26 KB - mental_v9i11e39122_app2.docx]

Multimedia Appendix 3
Overview of the minor themes of the qualitative results for the identified barriers and facilitators (each mentioned by fewer than 4 participants).
[DOCX File , 31 KB - mental_v9i11e39122_app3.docx]

Multimedia Appendix 4

Significant differences in barriers and facilitators between Prevention of Depression in Agriculturists (PROD-A) and Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists (PACT-A) interviewees based on the agreement rates in the quantitative follow-up survey.
[DOCX File , 23 KB - mental_v9i11e39122_app4.docx]

Multimedia Appendix 5
Descriptive statistics and Fisher exact test results of subgroup comparisons pertaining to completer status and study affiliation based on the agreement rates for the identified barriers and facilitators in the quantitative follow-up survey.
[XLSX File (Microsoft Excel File), 31 KB - mental_v9i11e39122_app5.xlsx]

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Abbreviations

COREQ: Consolidated Criteria for Reporting Qualitative Research
IBI: internet-based intervention
PACT-A: Preventive Acceptance and Commitment Therapy for Chronic Pain in Agriculturists
PROD-A: Prevention of Depression in Agriculturists
RCT: randomized controlled trial

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Original Paper

Health Needs for Suicide Prevention and Acceptance of e-Mental Health Interventions in Adolescents and Young Adults: Qualitative Study

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Abstract

Background: Adolescence is a phase of higher vulnerability for suicidal behavior. In Germany, almost 500 adolescents and young adults aged 15-25 years commit suicide each year. Youths in rural areas are characterized by a higher likelihood of poorer mental health. In rural areas, appropriate support for adolescents and young adults in mental health crises is difficult to access. The general acceptability of digital communication in youths can make the provision of an eHealth tool a promising strategy.

Objective: The aim of this study was to explore the health needs regarding suicide prevention for adolescents and young adults in rural areas of Germany and Switzerland and to identify characteristics of suitable e-mental health interventions.

Methods: This study reports on a qualitative secondary analysis of archived data, which had been collected through formative participatory research. Using 32 semistructured interviews (individually or in groups of 2) with 13 adolescents and young adults (aged 18-25 years) and 23 experts from relevant fields, we applied a deductive-inductive methodological approach and used qualitative content analyses according to Kuckartz (2016).

Results: Experts as well as adolescents and young adults have reported health needs in digital suicide prevention. The health needs for rural adolescents and young adults in crises were characterized by several categories. First, the need for suicide prevention in general was highlighted. Additionally, the need for a peer concept and web-based suicide prevention were stressed. The factors influencing the acceptability of a peer-driven, web-based support were related to low-threshold access, lifelike intervention, anonymity, and trustworthiness.

Conclusions: The results suggest a need for suicide prevention services for adolescents and young adults in this rural setting. Peer-driven and web-based suicide prevention services may add an important element of support during crises. By establishing such a service, an improvement in mental health support and well-being could be enabled. These services should be developed with the participation of the target group, taking anonymity, trustworthiness, and low-threshold access into account.

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KEYWORDS

suicide prevention; e-mental health; peer support; adolescents and young adults; health needs; acceptance; qualitative data analysis; suicide; mental health; teens; adolescent; young adult; vulnerable; behavior; Germany; rural; intervention; formative; digital; online

Introduction

Background: Prevalence of Mental Illness, Suicide, and Suicidal Ideation

Globally, mental illness and suicide are growing public health concerns [1,2]. Worldwide, more than 700,000 people die by suicide every year. Suicide is the fourth leading cause of death in young people aged 15-29 years [3]. Although the global suicide rate is 0.6 per 100,000 persons among adolescents aged ≤14 years [4], it reaches 7.4 per 100,000 persons among adolescents aged 15-19 years [5]. Risk factors for suicide in adolescents and young adults (AYA) include relationship breakdown, trauma, abuse, and a broken home combined with a low level of coping capability [6].

In Germany, almost 500 AYA aged 15-25 years commit suicide each year [7]. The suicide rate (per 100,000 inhabitants) in 2019 reached 0.6 deaths in adolescents aged ≤14 years, 4.1 deaths in those aged 15-19 years, and 6.2 deaths in young adults aged 20-24 years. This finding means that about 1 in 5 deaths between the ages of 15-24 years can be attributed to suicide (18.6% in those aged 15-19 years and 21.2% in those aged 20-24 year) [8].

Gender differences are expressed by 67.7% (105/155) male compared to 32.3% (50/155) female suicides in those aged 15-19 years and by 79.3% (260/328) male compared to 20.7% (68/328) female suicides in those aged 20-24 years [7]. Girls and young women are characterized by a higher prevalence of suicidal ideation than boys and young men of the same age (19.8% vs 9.3%). This difference in prevalence is also reflected in the percentage of suicide attempts (10.8% female vs 4.9% male suicide attempts). Repeated suicide attempts were assessed as 37% for males and 50% for female adolescents aged 15-19 years who already had made at least one attempt. In general, boys choose more lethal suicide methods than girls [9].

Another previous study [10] comparing suicidal ideation rates in cohorts of German university students between 2016 and 2020 reached 2 main findings: (1) suicidal ideation was more common in German students in 2020 than in the years before, and (2) depression levels were higher in 2020 than in 2016. The findings point to the substantial burden of the COVID-19 pandemic on young people. The authors emphasize that helplines and web-based counseling for depression and suicidal ideation should be promoted to the public and the potential support by e-mental health interventions for people who have suicidal behavior should be used and expanded [10].

Specifically in the context of rural areas, youths are characterized by a higher likelihood of poorer mental health. In Switzerland, living in a rural area was associated with an increased risk for suicide among adolescents aged 10-18 years [11]. In the United States, the incidence of suicide was higher in rural adolescents than in urban youths, and this gap has increased over time. Fewer youth-serving mental health or suicide prevention facilities were available in rural areas [12-14]. Poor coping skills combined with alcohol abuse have been found more often among adolescents in rural areas in Australia [15]. Compared to a representative German sample, young adolescents from rural areas in Germany had significantly lower levels of self-esteem [16]. Spatial data on youth suicide in Germany have not been published yet, and the situation of youths with mental health issues in rural areas is largely unknown.

Conventional Intervention Methods and Their Barriers in Rural Areas

Many AYA experience difficulties accessing mental health care and counseling [17], which has always been an issue in rural communities [18]. Independent of place, the stigma, shame, and helplessness related to mental illness and suicidal behavior seem to be a serious barrier for seeking treatment [19,20]. Further obstacles are the lack of accessible and acceptable mental health services and long wait times for initial consultations and therapy [21,22]. In addition to the already mentioned barriers to the use of psychosocial care in rural areas, another aspect is worth highlighting. Young people in rural areas are often dependent on their working parents to accompany them to (medical) appointments, as psychosocial care institutes are often far away from the place of residence, which can additionally cause the feeling of being a burden [23]. These issues may be exacerbated in rural areas.

Digital Solutions and Acceptance

To reach rural AYA effectively and comprehensively, a growing body of literature recommends the implementation of more affordable, accessible, and acceptable health services and support via e-mental health care solutions [24,25]. e-Mental health is defined by Christensen et al [26] as mental health services providing (1) information, (2) screening, (3) assessment and monitoring, and (4) intervention and social support, available or enhanced via the internet and related technologies.

e-Mental health has the potential to counteract the barriers of conventional offers by being available at times convenient for the client [19,27-29]. Most adolescents have access to the internet and feel competent using it [29,30]. The general acceptability of digital communication in youth can make the provision of an eHealth tool a promising strategy [19,21,31]. However, relatively few studies have addressed which of the various types of e-mental health services are accepted by rural AYA in crises and by experts who are relevant for the implementation of such services.

Therefore, the aim of this study was to explore in a rural context whether there are health needs for suicide prevention among AYA and what type of e-mental health tool would be accepted by rural AYA and relevant experts.

Methods

Recruitment and Data Collection

A qualitative research design was applied to comprehensively understand the need for an eHealth suicide prevention measure for children and AYA and to explore the acceptance of such an intervention. This study reports on a qualitative secondary analysis of archived data, which had been collected through formative participatory research [32]. The analysis consists of several projects differing in research aims such as the development of a digital suicide prevention application for youths or a strength, weakness, opportunities, and threats analysis of a nonprofit collaboration for suicide prevention for youths in a rural area. Above these particular aims, each of the parts was characterized by the broader aim to explore the need for (web-based, peer oriented) suicide prevention at rural sites in the south of Germany and Switzerland. The total data covering the overlapping aim have not been analyzed before.

The data were required to inform subsequent e-mental health intervention development. This participatory work aimed to explore local understandings of mental health and crisis intervention needs experienced by AYA. We were explicitly seeking the views not only of AYA themselves but also of experts in this field, acknowledging the potential of perceived local norms in designing a suitable intervention. The archived data presented a window into the social experience of AYA in small communities in Southwest Germany in the era just before the COVID-19 pandemic appeared. The area is characterized by a heterogeneous regional structure that includes metropolitan areas (eg, Stuttgart and Freiburg), peripheral zones, and the rural periphery (eg, Black Forest). Due to technological industries and tourism, this region is one of the most affluent areas in Germany.

Both expert interviews and interviews with the target group were conducted [33]. To gain as much interdisciplinary understanding of the topic as possible and to gather a rich and profound range of content, interviewees from different disciplines and occupational groups were acquired [34]. The interview guidelines had been tailored according to the role of the interviewee [35]. For instance, the experts were asked how they perceive the use of mental health services or support services for AYA in crisis situations compared between urban and rural areas. Regarding the peers, we aimed to identify the requirements for effective e-mental health services and the acceptance of web-based counseling compared to conventional offers. The target group were asked when and how they were confronted with the issue of suicidality and what possibilities they see to counteract the stigmatization of suicidality and mental illness.

The total number of the secondary data set was 38. We divided our AYA sample by age, and 2 AYA were excluded due to being underage. This study reports on AYA aged 18-25 years. Further demographics were not part of the study due to concerns regarding anonymity in this rural area. Therefore, our study is based on 32 single or tandem interviews separated according to experts and peers with 36 individuals in total (28 single interviews and 4 tandem interviews) and lasting from 22 to 85 minutes. The sample is shown in Table 1.

Table 1. Professional background and personal experience of the study sample (N=36).

Interviewee	Professional background and personal experience	Sample, n (n_{female}, n_{male})	Interview, n (n_{single}, n_{tandem})
Experts	• School social workers • Liaison teachers • Staff from crisis counseling centers • University psychologist • Grief counselor • Managing director of a professional self-help app for depression • Staff of the regional health care system	23 (20, 3)	21 (19, 2)
Peers	AYA[a]	9 (6, 3)	7 (5, 2)
Target group	• AYA who were diagnosed with a mental illness • AYA with suicidal ideation or past suicide attempt	4 (2, 2)	4 (4, 0)
Total	N/A[b]	36 (28, 8)	32 (28, 4)

[a]AYA: adolescents and young adults.

[b]N/A: Not applicable.

Data Analysis

Coding and data analysis were performed by an interdisciplinary research team, composed of 6 researchers from the fields of health sciences, social work, and psychology. Interview transcripts were analyzed in accordance with the qualitative content analysis following Kuckartz [33]. This is a rigorous qualitative method offering a reliable structure to the analysis of the interview transcripts. Coding was conducted in an iterative process [36]. We searched across the data and identified themes following the 7 phases of the analysis outlined by Kuckartz [36]. (1) Familiarizing ourselves with the data—individual transcripts were read and reread, and points of interest were noted. (2) Developing main topical categories—a list of initial codes was devised first from a deductive approach based on our research questions. In this step, we assigned preliminary themes based on the literature review and the interview guide, and then searched for passages referring to the need for peer-driven and web-based suicide prevention. We then continued analyzing from an inductive approach to ensure that further main topics

in the data were captured. This step was followed by (3) the initial coding process—coding the entire interview material using the main categories; (4) compiling all of the passages assigned to each of the main categories; (5) inductive determination of subcategories; (6) final coding of the entire material using the elaborate category system; and (7) simple and complex analysis. Codes of similar content were summarized to form subcategories. These subcategories in turn were grouped according to content, forming main categories. At each stage of the process, the researchers met to discuss codes and themes and resolve any discrepancies, verifying and refining the results.

Ethics Approval

The study was approved by the ethics committee of the Furtwangen University of Applied Sciences (Proposal 20-073).

Results

In all, 7 main categories were extracted from the qualitative data analysis: need for suicide prevention in general, need for a peer concept, need for web-based suicide prevention, low-threshold access, lifelike intervention, anonymity, and trustworthiness.

Need for Suicide Prevention in General

The rural region, where the interview took place, was characterized as a more conservative area where the dominating motto was that "here, the world is still all right." Youths were expected to get along better in these communities than in the "anonymous" cities. According to the experts we interviewed, AYA in crises can feel very lonely in this setting. Suicide rates as well as suicide attempt rates demand intervention: "When one sees how high the NEED among adolescents is, especially when looking at the number of suicide attempts" (Expert 1). Further, suicidal behavior is perceived as a "cry for help" from the young person:

> *...behind the numbers there are...fates and these fates are very different, but have one thing in common, that these young people were in a desperate situation and don't really want to die. Only they don't want to live like that anymore and don't see any alternative. And, every suicide attempt is a cry for help and unfortunately many calls for help then end in death, because the young people already consider this very carefully. "What do I do, how do I do it?" There are even these forums on the internet about setting a date for suicide.* [Expert 6]

Need for Peer Concept

Relevant characteristics of the supporting individuals are whether they are trained, whether they have experience with suicide and life crises, and whether they belong to the peer group: "[I think] that a peer hopefully understand peers better than anyone else, older, more studied" (Expert 7). Professional support can be augmented; it requires experience with the relevant social situations as well as a person who can relate with someone where they are at eye level with each other:

> *Then of course the eye-level with peers, that there are no adults...but also in the language of the young people...at eye-level, I think there are more adolescents to address.* [Expert 6]

Need for Web-Based Suicide Prevention

Young people have high expectations of service providers. Due to social and technological changes, they expect faster and always-accessible psychological care. The barrier to leave the house or to move to a counseling center can be addressed by support that is available independent of time of day, appointments, and accessibility:

> *We—adolescents are on mobile phones most of the time, and that's way better than going to some psychologist or someone else, just to make an appointment. Until you get one, I find such a quick help nearby is good.* [AYA 1]

There is an expanded need for alternative forms and concepts of intervention, especially for AYA. To counteract the lack of adequate support services in rural settings, the experts suggested web-based interventions: "As the target group of adolescents and children is addressed, this online consultation is just what exactly is in demand at the moment. We adolescents are daily on our phones " (AYA 5). This view is supported by another expert: "But of course, the digital offers are definitely a solution" (Expert 2).

To develop and implement an e-mental health intervention, such as an app, relevant characteristics have to be identified to promote the acceptance and use of this app in children and AYA. Experts and adolescents described several aspects of the acceptance of e-mental health such as low-threshold access, lifelike intervention, anonymity, and trustworthiness.

Low-Threshold Accessibility

The adolescents themselves mentioned that they often do not know how to get professional help in difficult situations and first look for information on the internet. It is often desired to list possible contact points in the app (AYA 6 and Expert 12). The experts confirmed a large service gap in relation to suicide prevention that may lead to "waiting lists" (Experts 3, 4, and 8 and AYA 3) in finding appointments in appropriate intervention services: "Since 2009, the demand is so high that we can no longer take everyone" (Expert 10). A psychologist described the temporally "limited possibilities...[of conventional counseling centers. Some of them are accessible only] a few hours a week...[and] do not have the setting for something like that, to address [the need]" (Expert 11). In addition, the problem of accessibility was expressed by a social worker who cares for adolescents in suicidal crises:

> *Then there are offices which are outsourced and only partially staffed and where you have to collect exact information, when there is anyone reachable, maybe Tuesday morning from 10 to 12 a.m. or so and I assume that it is for young people a lot harder because they are struggling to go anywhere anyway.* [Expert 9]

The experts report that an important determinant for the acceptance and use of an app is low-threshold access:

> *...common advantages are, of course, that it is accessible from anywhere, that it is, low-threshold and, in some ways, less judgmental or, more free or, more free apps should be used for suicide prevention...* [Expert 9]

Mobile apps and web-based advice offer users help in a simple and practical way. Nowadays, most adolescents have a smartphone and can be reached anywhere via the internet. Digital and technological advances (AYA 5) are being continuously developed. Youths in need of help can access and interact with a mobile app independent of time and place:

> *Of course it's the great thing when you say you have some online service or something...or an app where everyone can access it, no matter where I am. Or also independent of the time.* [Expert 1]

It would definitely be easier to find help by using a mobile app or accessing web-based advice than to make a phone call (AYA 2). An expert from a web-based counseling service had the experience "that it happens more often with the young people also by email that it is somehow again a smaller threshold than to have to call us" (Expert 1).

Lifelike Intervention

Due to this trend toward digitalization, smartphones are socially established and available to a large extend, especially among youths: "Because everyone has a mobile phone anyway and most of them are on it almost all the time anyway" (Expert 3). Although the older generations prefer personal conversations, young people spend a lot of time writing messages: "Well, the script-based is much more common than calling somewhere or something. Why do they use their smartphones, to write" (Expert 9).

In view of this, lifelike intervention should be integrated into their everyday life or their living space. As the target group always has the mobile phone at their disposal, it is already known that "The internet is principally our habitat" (AYA 5). Lifelike interventions should therefore serve the medium that the respective target group, in this case adolescents, already use in their everyday lives intensively.

Anonymity

Due to the fact that suicidality still is a taboo and that those affected are afraid of stigmatization and discrimination, they often avoid talking about their problems and renounce the use of therapies and preventive measures: "Many do not dare to go to someone and say they have depression or they are bullied or anything else" (Expert 3). e-Mental health interventions can be accessed on an anonymous basis, which can increase the use and acceptance of suicide prevention. Particularly among the target group of children and adolescents, the protection of anonymity seems to have a high priority. Based on anonymity, it is easier for adolescents to open up and develop trust: "I think that it is a great advantage of online counseling, because this trust works much more easily, because this anonymity is there" (Expert 1). Especially, male adolescents may benefit from anonymous web-based interventions, as young men appear to be particularly vulnerable and have higher rates of suicide:

> *...they do not even have to reveal whether they are male or female, but it runs anonymously and they can hide behind it and, it can be said, it's like a camouflage hideout with a small hole. Then they contact the outside, so us and besides they are well protected and out of this protection I think they are also more courageous and approachable.* [Expert 6]

Anonymity has a strong impact on young people's behavior as they gain trust more easily and become more cooperative and self-confident.

Trustworthiness

Essentially, there is the problem that "there are a thousand apps and you think so...That it is not seen as professional help. Probably. You don't know who developed it, why you developed it and who is behind it" (AYA 2). This can be counteracted by increasing the trustworthiness of web-based counseling. Ratings are important when using an app, and the users try to select the best fitting e-mental health interventions and to build up a basis of trust in the app and the offer:

> *...I think I have to read through some references on the internet before I would trust them I say now but I find a good idea in every case that somebody is there for such a person so how it reaches the individual is then I think more personal...* [AYA 3]

An expert suggested that a well-respected person in local life, who is accepted by the target group, should be used as a kind of "role model" or patron. "If, for example, a famous person, a doctor, a professor, talks about it and says that it helps you and will recommend it as well" (AYA 2), more young people might also be encouraged to get this help. The factor of trustworthiness is strongly influenced by the particular person who is in charge of the individual seeking help: "if I just had an app and write and if [I get] a trained [professional] one who answers me that has no idea...how trustworthy is that or how safe can you be" (AYA 4).

In summary, experts as well as AYA have reported health needs in digital suicide prevention. The acceptance of an e-mental health intervention in the vulnerable group of rural adolescents may be increased by low-threshold access, lifelike intervention, as well as anonymity and trustworthiness.

Discussion

Principal Findings

This is the first study investigating the need and acceptability of e-mental health among AYA in rural areas in Germany and Switzerland. The interviews reflected that there is a high need for improvement in the area of e-mental health suicide prevention. Based on 32 qualitative interviews (with 36 individuals), 4 subcategories were extracted that may enhance the acceptability for suicide prevention. These included *low-threshold access*, *lifelike and authentic intervention*, *anonymity*, and *trustworthiness*. The results of this study indicate that these AYA often feel powerless and "lost" in the mental

health care system and that pathways of help in critical situations are often unclear. Suicidality still is a taboo and those affected may be afraid of stigmatization and discrimination by society and may hesitate to seek help and professional support [18,27,37]. They avoid talking about their problems and refrain from therapies and preventive measures. Pauwels et al [19] and Kennedy et al [17] also found that the stigmatization and fear of exclusion may hamper the use of suicide prevention assistance, especially in male adolescents.

Another important result is the large gap in suicide prevention services due to long wait times. In difficult situations, psychiatric intramural care can be the only available option, and adolescents in rural settings may be even more afraid of being admitted to a psychiatric hospital away from their home. Our results confirm the studies of Nübling et al [21] and Pisani et al [22] in terms of a lack of psychotherapists and difficulties in the accessibility of demand-oriented care for suicidal children and adolescents. Our results support the idea of improving e-mental health intervention measures to get fast and always-accessible psychological support. In this framework, the particular content and strategy of support could be designed by a professional and peer team in the background, whereas the communication with the help-seeking adolescent can be conducted by a peer. In addition, our study confirms that young people feel accepted and supported by their peers [38]. However, although some studies found support for the positive consequences of peer support for adolescents in crises, there are not enough randomized studies yet to promote the peer concept in general [39-41].

e-Mental health can provide a simple and practical way for those seeking help. Due to increasing digitalization, most AYA have a smartphone with internet access and use it frequently [30]. Thus, the widespread use of smartphones enables low-threshold access that makes it easier for young people to find help with e-mental health. Compared to traditional analog support services, e-mental health offers young people the advantage of not having to seek help in their personal environment. In our sample, web-based counseling experts pointed out that it can be more convenient and familiar for rural young people to write an email instead of calling their doctors, therapists, and other service providers, who may be difficult to reach. This finding supports the work of other studies [28,29] that stress the high acceptance of mobile apps and point out that anonymity and low-threshold access via the internet can improve the use of suicide prevention services. These characteristics may be of utmost importance in rural areas where sociocultural barriers—such as a fear of gossip, a preference for self-reliance, and informal sources of help (eg, friends and family)—as well as the general reluctance to acknowledge mental health problems along with limited mental health literacy may additionally hamper help seeking. Geographic and financial barriers such as limited availability of transport can contribute to difficulties associated with help seeking in rural settings [19-22]. Web-based services may improve rural young people's use of the broader mental health system in general.

Strength and Limitations

We collected several interviews of experts and adolescents from various demographic and occupational backgrounds, providing a basic picture of the expressed needs of rural AYA and experts involved. From a methodological perspective, we summed up a heterogeneous sample and were able to form special subcategories for more detailed analysis through the inductive procedure. Although all the researchers have extensive knowledge in the field of public health and health promotion, only 3 of them are experts in suicide prevention, so the approach to the data was largely unbiased. A limitation is that the interviewees stemmed from only 1 local region (Southwest Germany and a small part of Switzerland). Furthermore, it can be noted that there is an assumption that the use and extent as well as the acceptance of the digital world are ubiquitous, which is not always the case. In sum, the study indicates a need for further research in digital suicide prevention.

Conclusion

The results suggest a need for suicide prevention services for adolescents in this rural setting. Peer-driven e-mental health suicide prevention for AYA may add an important element of support during crises in this age group. These offers should be developed with participation from the target group, taking anonymity, trustworthiness, and low-threshold access into account. Further studies with rural adolescents will be needed, in particular to explore usage and effectiveness.

e-Mental health intervention in general may provide an opportunity to raise mental health awareness. In summary, these findings may add an important contribution to public health approaches aimed at improving the mental health and well-being of AYA living in rural areas.

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Conflicts of Interest

None declared.

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Abbreviations

AYA: adolescents and young adults

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Original Paper

Cost-Utility and Cost-effectiveness of MoodSwings 2.0, an Internet-Based Self-management Program for Bipolar Disorder: Economic Evaluation Alongside a Randomized Controlled Trial

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Abstract

Background: Internet-delivered psychosocial interventions can overcome barriers to face-to-face psychosocial care, but limited evidence supports their cost-effectiveness for people with bipolar disorders (BDs).

Objective: This study aimed to conduct within-trial cost-effectiveness and cost-utility analyses of an internet-based intervention for people with BD, MoodSwings 2.0, from an Australian health sector perspective.

Methods: MoodSwings 2.0 included an economic evaluation alongside an international, parallel, and individually stratified randomized controlled trial comparing an internet-based discussion forum (control; group 1), a discussion forum plus internet-based psychoeducation (group 2), and a discussion forum plus psychoeducation and cognitive behavioral tools (group 3). The trial enrolled adults (aged 21 to 65 years) with a diagnosis of BD assessed by telephone using a structured clinical interview. Health sector costs included intervention delivery and additional health care resources used by participants over the 12-month trial follow-up. Outcomes included depression symptoms measured by the Montgomery-Åsberg Depression Rating Scale (MADRS; the trial primary outcome) and quality-adjusted life years (QALYs) calculated using the short-form 6-dimension instrument derived from the 12-item version of the short-form health survey. Average incremental cost-effectiveness (cost per MADRS score) and cost-utility (cost per QALY) ratios were calculated using estimated mean differences between intervention and control groups from linear mixed effects models in the base case.

Results: In total, 304 participants were randomized. Average health sector cost was lowest for group 2 (Aus $9431, SD Aus $8540; Aus $1=US $0.7058) compared with the control group (Aus $15,175, SD Aus $17,206) and group 3 (Aus $15,518, SD Aus $30,523), but none was statistically significantly different. The average QALYs were not significantly different among the groups (group 1: 0.627, SD 0.062; group 2: 0.618, SD 0.094; and group 3: 0.622, SD 0.087). The MADRS scores were previously shown to differ significantly between group 2 and the control group at all follow-up time points (P<.05). Group 2 was dominant (lower costs and greater effects) compared with the control group for average incremental cost per point decrease in MADRS

score over 12 months (95% CI dominated to Aus $331). Average cost per point change in MADRS score for group 3 versus the control group was dominant (95% CI dominant to Aus $22,585). Group 2 was dominant (95% CI Aus $43,000 to dominant) over the control group based on lower average health sector cost and average QALY benefit of 0.012 (95% CI –0.009 to 0.033). Group 3, compared with the control group, had an average incremental cost-effectiveness ratio of dominant (95% CI dominated to Aus $19,978).

Conclusions: Web-based psychoeducation through MoodSwings 2.0 has the potential to be a cost-effective intervention for people with BD. Additional research is needed to understand the lack of effectiveness for the addition of cognitive behavioral tools with the group 3 intervention.

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KEYWORDS

economic evaluation; cost-effectiveness; cost-utility; clinical trial; bipolar disorder; psychoeducation; cognitive behavioral therapy; internet intervention; mania; depression; psychiatry; neuroscience; mental disorders

Introduction

Background

Bipolar disorder (BD) is a complex mental health condition with multiple and varying states ranging from elevated mood (mania or hypomania) to feelings of hopelessness and sadness (depression) [1]. It consists of several related diagnoses representing a spectrum of illness, including bipolar type I, bipolar type II, cyclothymia, and bipolar not elsewhere classified. The global prevalence of bipolar spectrum disorders is estimated at 0.741% of the adult population, and BD is associated with significant disability and costs to both health care systems and society [2-4].

The primary therapy for BD consists of mood stabilizing medications, including lithium, antipsychotics, and anticonvulsants [5-13]. Psychosocial therapies, including psychoeducation and cognitive behavioral therapy (CBT), are recommended as add-on therapy to medications to reduce relapse through improved medication adherence, identification of early warning signs, self-management, and family communication [14,15]. Psychosocial therapies delivered through traditional face-to-face methods have been shown to be effective and cost-effective adjunctive treatments to pharmacotherapy for people with BD [16-18] and other mental health diagnoses such as anxiety and depression [19].

Objectives

Internet-delivered psychosocial therapies can overcome several barriers faced when seeking mental health care, such as geographic location, a limited number of service providers, and the cost of treatment. Internet-delivered psychosocial therapies have been shown to be effective and cost-effective for the treatment of depression and anxiety [20,21]. However, the evidence to support the effectiveness and cost-effectiveness of internet-based psychosocial therapies for people with BDs is limited [18,22]. To fill this gap, the MoodSwings 2.0 randomized controlled trial (RCT) was conducted to investigate the efficacy of an internet-based self-guided psychosocial intervention for people with BD [23]. This analysis reports on the within-trial economic evaluation of MoodSwings 2.0 from an Australian health sector perspective.

Methods

Overview

This economic evaluation was conducted alongside the RCT of MoodSwings 2.0 (ClinicalTrials.gov NCT02118623 [Australia] and NCT02106078 [United States]) that recruited study participants on the web from anywhere in the world. The RCT was run from 2 study sites located in Geelong, Victoria, Australia, and Palo Alto, California, United States. Details of the study conduct and analysis of the primary study outcomes have been described elsewhere [23].

In brief, adults (aged 21-65 years) with a diagnosis of BD type I, BD type II, or BD not elsewhere classified assessed by telephone using the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, were eligible. Additional eligibility criteria included access to emergency care, visiting a health care provider at least twice per year for BD treatment, access to the internet and a computer, fluency in English, competence to provide informed consent, and willingness to provide emergency contact details. Once consent was obtained and inclusion and exclusion confirmed, we randomized participants on the secure website to 1 of 3 conditions:

- Group 1: discussion forum only (control)
- Group 2: discussion forum plus psychoeducational modules
- Group 3: discussion forum and psychoeducational modules plus CBT-based interactive tools

Two-step block randomization was used and coded into the website during development. Research staff members were unable to view the randomization code.

For 12 months from randomization, all participants had access to the MoodSwings 2.0 website and their study arm–specific asynchronous peer discussion forum. Moderators screened discussion posts and edited or deleted those with personal contact information, profanity, or distressing content. Group 2 participants were additionally able to access 5 psychoeducational modules delivered biweekly, followed by 4 booster modules delivered at 3, 6, 9, and 12 months. The psychoeducation modules were adapted from a face-to-face clinician-facilitated manualized program, previously evaluated in randomized evaluations [24-26]. The participants randomized to group 3

were able to access the discussion forum, psychoeducation modules, and interactive CBT-based tools. This included development of a life chart, thought monitoring, simple motivational interviewing techniques, self-reflection, problem solving, identification of personal triggers, and a relapse-prevention plan [27].

Ethics Approval

This analysis was undertaken with data collected as part of the RCT approved by the institutional review board at Stanford University (Stanford, California, United States; project ID 21897) as well as the human research ethics committees at Barwon Health (Geelong; EC00208, project ID 11/73) and Deakin University (Geelong; EC00213, project ID 2021-072). The study was conducted in accordance with the ethical standards of the responsible committees.

Costs

The recommendations for economic analyses within an international trial suggest that resource use is costed with local unit costs, followed by analysis of heterogeneity [28]. This method requires country-specific unit costs from collaborators. As this study recruited participants on the web from multiple countries, local unit costs were difficult to source. The trial was managed from Australia and the United States, and an Australian health sector perspective was adopted for the economic evaluation. Health sector costs included the costs to deliver the interventions as well as the costs of other health services used by participants during the trial period (refer to Table S1 in Multimedia Appendix 1 [29]).

A microcosting approach was used to estimate the cost to deliver the 3 interventions. We estimated the personnel time required to monitor the internet-based forums as well as time for debriefing with a supervisor. Personnel costs were calculated by multiplying estimated hours by the average wage rate of a research assistant or supervisor, both with 25% added to account for employer overhead costs (eg, space and administrative overheads).

The cost of 2 desktop computers required for research assistants to monitor the internet-based forums was estimated based on an annual lease cost of Aus $800 (Aus $1=US $0.7058) per computer multiplied by the estimated time required to conduct the study (2.24 years).

The development and maintenance cost of the MoodSwings 2.0 website was provided by the study team as a single estimate. This total cost was apportioned across the 3 internet-based interventions based on complexity. The average health sector cost for each intervention group was then calculated based on the number of trial participants.

Information on participant health service use was captured through a self-report resource use questionnaire, the Cornell Service Index [30], at baseline and 3-, 6-, 9-, and 12-month follow-ups. The Cornell Service Index questionnaire asked about the number and types of medical, psychological, acute care, and support services accessed by study participants in the preceding 3 months. Standard Australian unit costs were applied. Intervention costs were added to the 3month health service costs; next, all health care service use costs over the 3- to 12-month follow-ups were summed.

All costs were presented in 2018-19 Australian dollars (Aus $). Discounting was not applied because the study time horizon was 12 months.

Outcomes

Self-report outcome measures were administered at baseline and 3-, 6-, 9-, and 12-month follow-ups, including the Montgomery-Åsberg Depression Rating Scale (MADRS), Young Mania Rating Scale, and the short-form health survey, 12-item version (SF-12). The MADRS score was a coprimary outcome measure that achieved statistically significant differences among the groups. It was used as an outcome measure for the cost-effectiveness analysis.

The SF-12 was used to measure participants' health-related quality of life at each assessment time point. A preference-based scoring algorithm using British general population preference weights was applied to calculate utility values at each time point based on 6 questions from the SF-12 (short-form 6-dimension [SF-6D] instrument) [31]. Quality-adjusted life years (QALYs) were then calculated from the SF-6D utility values using the area under the curve method [32]. The use of QALYs in an economic evaluation is also referred to as a cost-utility analysis [33].

Statistical Analyses

Statistical analyses were conducted using Stata software (version: 17.0; StataCorp LLC). Base case analyses were conducted on an intention-to-treat basis, including all participants with a baseline assessment. Missing cost and utility data were reported using descriptive statistics. The investigation of relationships between complete cost and outcome data with demographic and clinical variables was undertaken using logistic regression analysis.

Costs and utility values were reported at each time point by randomized group using descriptive statistics (mean and SD). The base case analysis used linear mixed effects models to evaluate between-group differences in postbaseline health sector costs, SF-6D utility values, and QALYs. Health sector costs and SF-6D utility values at each follow-up were regressed on time, baseline value, and treatment allocation with adjustment for baseline covariates specified a priori (baseline cost or utility, sex, and national origin). The model accounted for autocorrelation because of repeated measures across follow-ups and used an unstructured covariance matrix that allows all variances and covariances to be distinct.

Incremental cost-effectiveness ratios (ICERs) were calculated as the mean difference in total health sector costs between 2 randomized groups divided by the mean difference in MADRS scores. The 12-month follow-up was considered the primary time point for comparison in the main efficacy analysis, and this time point was adopted for the cost-effectiveness analysis. A nonparametric bootstrap procedure with 1000 iterations was used to calculate CIs around ICERs. Cost-effectiveness planes were constructed by plotting the 1000 bootstrapped incremental costs and incremental MADRS scores.

The incremental cost-utility ratio was calculated by dividing the mean difference in total health sector cost by the mean difference in QALYs. A nonparametric bootstrap procedure with 1000 iterations and the reordered bootstrap percentile method (1000 iterations) was used to estimate 95% CIs around each average incremental cost-utility ratio [34]. An intervention was considered cost-effective if the resulting ICER fell below the generally accepted Australian willingness-to-pay threshold of Aus $50,000 per QALY [35]. The resulting bootstrap iterations were also used to construct cost-effectiveness planes and acceptability curves to represent the uncertainty in the ICER.

Sensitivity analyses were undertaken to test the assumptions regarding missing data, including complete case analysis and multiple imputation for missing data at follow-up [36]. Missing total cost and outcomes data (utility values and MADRS scores) at each time point (3-, 6-, 9-, and 12-month follow-ups) were imputed through a resampling method using single imputation nested in bootstrapping [37]. This method generated a single call to the multiple imputation function in Stata, with chained equations and predictive mean matching, to produce a complete data set. The costs and outcomes were then analyzed with generalized linear models (GLMs) for each bootstrap resample. After the generation of 1000 bootstrap resamples, the reordered bootstrap percentile method was used to estimate 95% CIs around each average ICER [34]. In these sensitivity analyses the mean difference in total health sector costs over the 12-month follow-up among the randomized groups was estimated using GLMs [38] with the gamma family and identity link. The mean difference in QALYs among the randomized groups was estimated using GLMs with inverse gaussian family and identity link. All statistical models were estimated with adjustment for baseline covariates specified a priori (baseline cost or utility, sex, and national origin). The choice of family for each GLM was based on results from modified Park tests [38]. The link for each model was chosen based on a combination of Pearson correlation, Pregibon link, and modified Hosmer-Lemeshow tests [38].

An additional sensitivity analysis was conducted by estimating the intervention cost from population-level rollout. The average cost per study participant for variable cost items (personnel and computers) was added to the average cost of website development and maintenance per potentially eligible Australian with a diagnosis of BD. To provide a conservative estimate of potential users of the MoodSwings 2.0 program, the number of people with BD seeking care was estimated by multiplying the age- and sex-based prevalence of BD by Australian demographic statistics for the population aged 25 to 65 years in June 2018 [2,39]. The estimate was then multiplied by the percentage of people with BD using health care services for their mental health (67.7%) based on an Australian population-based mental health survey [40].

A threshold analysis was also undertaken to estimate the group 2 intervention cost required for the total cost to be the same as group 1 (control).

Results

Participant Characteristics

A total of 322 people provided consent and were screened for eligibility, with 304 (94.4%) participants randomized (refer to Figure S1 in Multimedia Appendix 1 [23]). There were no significant differences in baseline characteristics across the randomized groups (Table 1).

Self-reported resource use from the Cornell Service Index questionnaire and quality of life from the SF-12 were completed by 91.4% (278/304) of the participants at baseline, 39.5% (120/304) at 3-month, 33.9% (103/304) at 6-month, 35.5% (108/304) at 9-month, and 29.3% (89/304) at 12-month follow-ups (Table S2 in Multimedia Appendix 1). Overall, of the 304 participants, there were 84 (27.6%) with complete costs and QALYs over the 5 data collection points during the 12-month study period. Comparisons of participants with complete and incomplete data over the entire 12-month period found that sex was the only variable related to incomplete data; however, this may be due to the high percentage of female participants enrolled in the trial (228/278, 82%). It is unlikely that these data were missing not at random, given the similar patterns of missing cost and utility data that were observed across participants; as well as the qualitative differences between missing cost and utility data and their underlying values. On the basis of our exploratory analyses of missing data mechanisms, it was inferred that incomplete cost and utility data were missing at random. Multiple imputation was consequently used to account for missing data, while incorporating sex as a covariate.

Table 1. Baseline demographic characteristics of participants randomized to group 1 (control), group 2 (psychoeducation), or group 3 (cognitive behavioral therapy).

	Group 1 (control; n=102)	Group 2 (n=102)	Group 3 (n=100)	Overall sample (N=304)
Age (years), mean (SD)	39.86 (10.62)	38.65 (11.85)	39.93 (11.15)	39.47 (11.19)
Sex, female, n (%)[a]	77 (75.5)	79 (77.5)	72 (72)	228 (82)
Country, n (%)[a]				
United States	41 (40.2)	37 (36.3)	29 (29)	107 (38.5)
Australia	32 (31.4)	35 (34.3)	26 (26)	93 (33.5)
Other	23 (22.5)	23 (22.5)	32 (32)	78 (28.1)
Bipolar type, n (%)				
I	50 (49)	62 (60.8)	55 (55)	167 (54.9)
II	41 (40.2)	36 (35.3)	38 (38)	115 (37.8)
Not elsewhere classified	11 (10.8)	4 (3.9)	7 (7)	22 (7.2)
Working, n (%)[a]	45 (48)	42 (44.7)	48 (55.2)	135 (49.1)
Full time	26 (27.7)	22 (23.4)	28 (32.2)	76 (27.6)
Part time	16 (17)	14 (14.9)	12 (13.8)	42 (15.3)
Casual	3 (3.2)	6 (6.4)	8 (9.2)	17 (6.2)
Studying, n (%)[a]	19 (20)	19 (20)	25 (28.7)	63 (22.7)
Full time	5 (5.3)	2 (2.1)	10 (11.5)	17 (6.1)
Part time	14 (14.7)	17 (17.9)	15 (17.2)	46 (16.6)

[a]Of the 304 participants, only 278 (91.4%) completed the sex and national origin questions, 275 (90.5%) completed the work status questions, and 277 (91.1%) completed the study status questions.

Costs

Table 2 details the resources required, unit costs, and total costs for intervention delivery across the randomized groups. The average cost to deliver the control group intervention was estimated at Aus $421 per randomized participant. Group 2 and group 3 delivery costs were estimated at Aus $645 and Aus $714 per randomized participant, respectively.

The average health sector costs at each time point and totaled over the 12-month follow-up are detailed in Table S3 in Multimedia Appendix 1. The average health sector costs were not significantly different among the groups at baseline or over the 4 individual follow-up periods, except for a significant difference between group 2 and group 3 at 6-month follow-up (P=.01). The total average health sector cost, including the intervention cost, was lower for group 2 (Aus $9431) than for the control group (Aus $15,175), but this difference was not statistically significant. The total average health sector costs, including the intervention delivery costs, were comparable for group 3 and group 1 (control).

Table S4 in Multimedia Appendix 1 provides the average costs and SDs for participants who completed all Cornell Service Index questionnaires between 3 and 12 months by service use category across the randomized groups. The largest difference among the groups was noted for acute care costs between group 2 (mean Aus $1015, SD Aus $2206) and group 1 (mean Aus $6040, SD Aus $15,152).

Table 2. Intervention costs, in Australian dollars (Aus $1=US $0.7058), by randomized group.

Item	Group 1 (control; n=102; forum only)	Group 2 (n=102; forum + psychoeducation)	Group 3 (n=100; forum + psychoeducation + CBT[a] tools)	Overall sample (N=304)
Website development and maintenance	22,800.00	45,600.00	51,600.00	120,000.00
Desktop computers	1204.59	1204.59	1,180.97	3590.14
Personnel				
Research assistant (monitoring)	14,778.81	14,778.81	14,489.03	44,046.65
Research assistant (debriefing)	1477.88	1477.88	1448.90	4404.66
Supervisor (debriefing)	2689.53	2689.53	2636.79	8015.85
Total intervention cost	42,950.80	65,750.80	71,355.69	180,057.29
Average cost per trial participant	421	645	714	592

[a]CBT: cognitive behavioral therapy.

Health Outcomes

The average MADRS scores were significantly different between group 2 and group 1 (control) at all follow-up time points ($P \leq .05$), with a mean difference ranging between 3.6 (95% CI –0.001 to 7.2; 9-month follow-up) and 5.5 points (95% CI 1.8-9.2; 6-month follow-up; Table 3 and Table S5 in Multimedia Appendix 1 [23]). The only significant difference in MADRS scores between group 3 and group 1 (control) was at 6 months with a mean difference of 4.8 points (95% CI 1.0-8.5; $P=.01$).

The average SF-6D utility value was 0.63 at baseline across the randomized groups. From baseline to 12-month follow-up the average QALYs per group were not significantly different, with mean QALYs of 0.627 (SD 0.062) in group 1, 0.618 (SD 0.094) in group 2, and 0.622 (SD 0.087) in group 3 (Table S6 in Multimedia Appendix 1).

Table 3. Incremental cost-effectiveness ratios (ICERs), in Australian dollars (Aus $1=US $0.7058), by follow-up period and randomized group.

	Health care costs, mean difference (95% CI)	MADRS[a] score, mean difference (95% CI)	Cost per point change in MADRS score (ICER)
Comparison of group 2 vs group 1 (control)			
3-month follow-up	–19 (–1677 to 1640)	4 (0.1 to 7.9)	Dominant[b]
6-month follow-up	–1300 (–4721 to 2210)	5.5 (1.8 to 9.2)	Dominant
9-month follow-up	–879 (–4688 to 2929)	3.6 (–0.001 to 7.2)	Dominant
12-month follow-up	–659 (–3488 to 2170)	3.8 (0.01 to 7.6)	Dominant
Total 3 to 12 months	–2858 (–10,909 to 5194)	3.8 (0.01 to 7.6)[c]	Dominant (dominated[d] to 331)
Comparison of group 3 vs group 1 (control)			
3-month follow-up	113 (–3804 to 4030)	1.1 (–2.8 to 4.9)	103
6-month follow-up	–348 (–4639 to 4944)	4.8 (1.0 to 8.5)	Dominant
9-month follow-up	–601 (–3957 to 2754)	2.5 (–1.2 to 6.2)	Dominant
12-month follow-up	743 (–3957 to 2754)	3.6 (–0.4 to 7.5)	206
Total 3 to 12 months	–94 (9422 to 9235)	3.6 (–0.4 to 7.5)[c]	Dominant (dominant to 22,585)
Comparison of group 2 vs group 3			
3-month follow-up	581 (3747 to 4888)	–1.9 (–6.9 to 3.1)	Dominated
6-month follow-up	4339 (940 to 7738)	–1.1 (–5.7 to 3.5)	Dominated
9-month follow-up	466 (–2853 to 3784)	0.3 (–5.0 to 4.4)	1553
12-month follow-up	2423 (–845 to 5691)	0.7 (–5.7 to 3.5)	3461
Total 3 to 12 months	7798 (–2,303 to 17,900)	0.7 (–5.7 to 3.5)[c]	11,140 (dominant to 147)[e]

[a]MADRS: Montgomery-Åsberg Depression Rating Scale.

[b]Less costly and more effective.

[c]The 12-month follow-up was used because this was the time point prespecified as the primary outcome comparison.

[d]More costly and less effective.

[e]The results are spread across all 4 quadrants of the cost-effectiveness plane, making the CI difficult to interpret.

Cost-effectiveness and Cost-Utility

The average incremental cost per point improvement in MADRS scores for group 2 versus group 1 (control) was dominant at each follow-up time point and when summed over the study period (Table 3 and Figure 1). Dominant refers to the scenario when average incremental costs were lower and average incremental effects were higher for the intervention compared with the control group. The 95% CI ranged from dominated (higher incremental cost and negative incremental effect) to Aus $331 per point improvement in MADRS score.

The average costs per point improvement in MADRS score for group 3 versus the control group range from dominant (6- and 9-month follow-ups) to Aus $206 (12-month follow-up). Combining costs over the entire study follow-up leads to the group 3 intervention being dominant (less costly and more effective), with a wide CI from dominant to Aus $22,585 per point improvement in MADRS score (Table 3 and Figure 2).

The average costs per point improvement in MADRS score for group 2 versus group 3 range from Aus $1553 (9-month follow-up) to dominated (more costly and less effective at 3- and 6-month follow-ups). Over the entire 12-month period, the average ICER was Aus $11,140 per point change in MADRS score, with a wide spread of bootstrap iterations across all 4 quadrants of the cost-effectiveness plane making it difficult to interpret the CI (Table 3 and Figure 3).

The base case cost-utility analysis found that group 2 would be considered the dominant strategy compared with the control group based on the lower average health sector cost and an average QALY benefit of 0.012. The 95% CI for the average incremental cost-utility ratio ranged from Aus $43,000 per QALY to dominant (Table 4 and Figure 4); the lower CI was a result of lower costs and lower incremental QALYs. There was a 79% probability that the psychoeducation modules would be cost-effective at the threshold of Aus $50,000 per QALY.

The base case average incremental health sector cost for group 3 compared with the control group was estimated at –Aus $94 with an average benefit of 0.002 QALYs resulting in a dominant average ICER (95% CI dominated to –Aus $19,978; Table 4 and Figure 5). The CI is difficult to interpret because the bootstrap iterations span all 4 quadrants on the cost-effectiveness plane. The probability of the combination of psychoeducation

and CBT tools being cost-effective at the threshold of Aus $50,000 per QALY was estimated at 51%.

Group 3 was dominated by group 2 in the base case because of higher average costs (Aus $7798) and fewer QALYs (–0.004; Table 4 and Figure 6). At the willingness-to-pay threshold of Aus $50,000 per QALY, the probability that the group 3 intervention would be cost-effective compared with the group 2 intervention was estimated at 7%.

Figure 1. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 2 versus control cost per Montgomery-Åsberg Depression Rating Scale (MADRS) score improvement bootstrapped from complete cases.

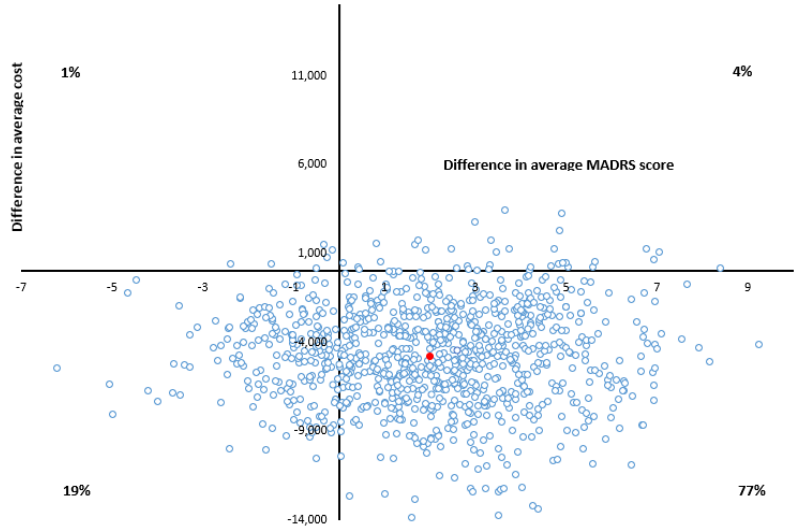


Figure 2. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 3 versus control cost per Montgomery-Åsberg Depression Rating Scale (MADRS) score improvement bootstrapped from complete cases.

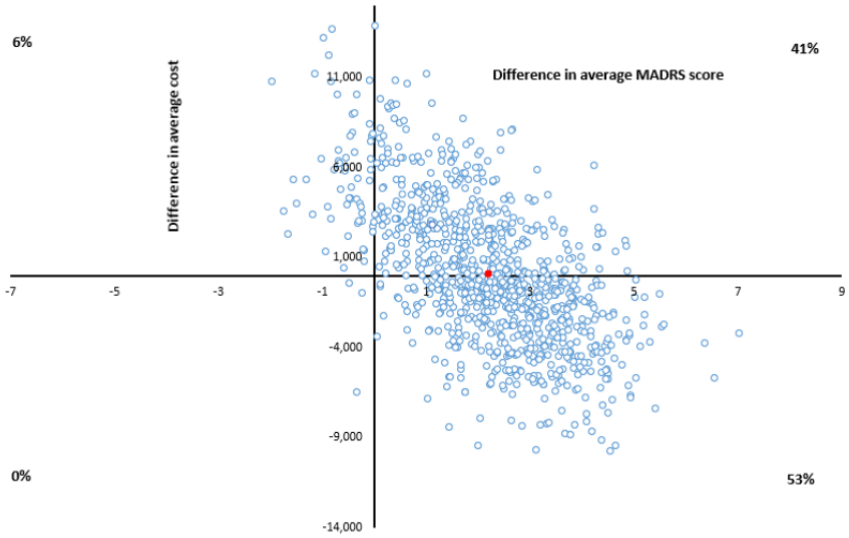


Figure 3. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 2 versus group 3 cost per Montgomery-Åsberg Depression Rating Scale (MADRS) score improvement bootstrapped from complete cases.

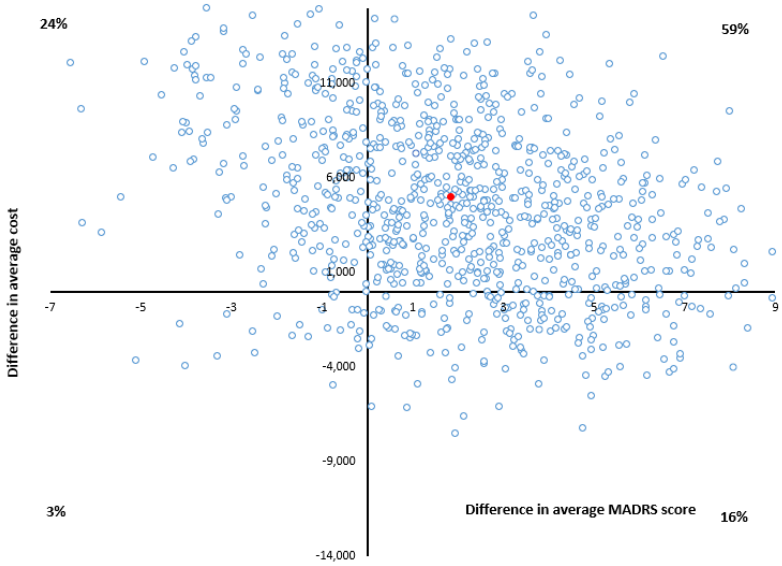


Table 4. Incremental cost-utility ratios, in Australian dollars (Aus $1=US $0.7058), by follow-up period and randomized group.

	Health care costs, mean difference (95% CI)	Utilities and QALYs[a], mean difference (95% CI)	Cost per QALY, ICER[b] (95% CI)
Comparison of group 2 vs group 1 (control)			
3-month follow-up	–19 (–1677 to 1640)	0.0005 (–0.003 to 0.004)	__[c]
6-month follow-up	–1300 (–4721 to 2210)	0.003 (–0.003 to 0.010)	—
9-month follow-up	–879 (–4688 to 2929)	0.004 (–0.003 to 0.01)	—
12-month follow-up	–659 (–3488 to 2170)	0.004 (–0.004 to 0.013)	—
Total 3 to 12 months	–2858 (–10,909 to 5194)	0.012 (–0.009 to 0.033)	Dominant (43,000 to dominant)[d]
Comparison of group 3 vs group 1 (control)			
3-month follow-up	113 (–3804 to 4030)	0.0007 (–0.004 to 0.005)	—
6-month follow-up	–348 (–4639 to 4944)	0.002 (–0.007 to 0.010)	—
9-month follow-up	–601 (–3957 to 2754)	–0.0005 (–0.008 to 0.007)	—
12-month follow-up	743 (–3957 to 2754)	–0.0004 (–0.011 to 0.010)	—
Total 3 to 12 months	–94 (–9422 to 9235)	0.002 (–0.023 to 0.027)	Dominant (dominated to 19,978)[e]
Comparison of group 2 vs group 3			
3-month follow-up	581 (3747 to 4888)	0.002 (–0.002 to 0.006)	—
6-month follow-up	4339 (940 to 7738)	0.004 (–0.004 to 0.012)	—
9-month follow-up	466 (–2853 to 3784)	–0.006 (–0.014 to 0.002)	—
12-month follow-up	2423 (–845 to 5691)	–0.003 (–0.012 to 0.007)	—
Total 3 to 12 months	7798 (–2303 to 17,900)	–0.004 (–0.028 to 0.021)	Dominated (dominated to 21,287)

[a]QALY: quality-adjusted life year.

[b]ICER: incremental cost-effectiveness ratio.

[c]Incremental cost ratio not calculated.

[d]The lower CI is a result of lower costs and fewer incremental quality-adjusted life years.

[e]The bootstrap results are spread across all 4 quadrants of the cost-effectiveness plane, making the CI difficult to interpret.

Figure 4. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 2 versus control cost per quality-adjusted life year (QALY) bootstrapped from complete cases.

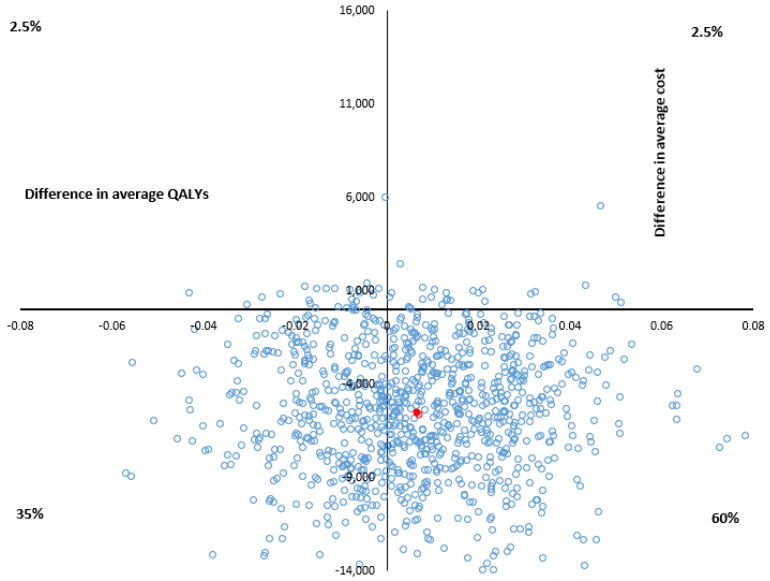


Figure 5. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 3 versus control cost per quality-adjusted life year (QALY) bootstrapped from complete cases.

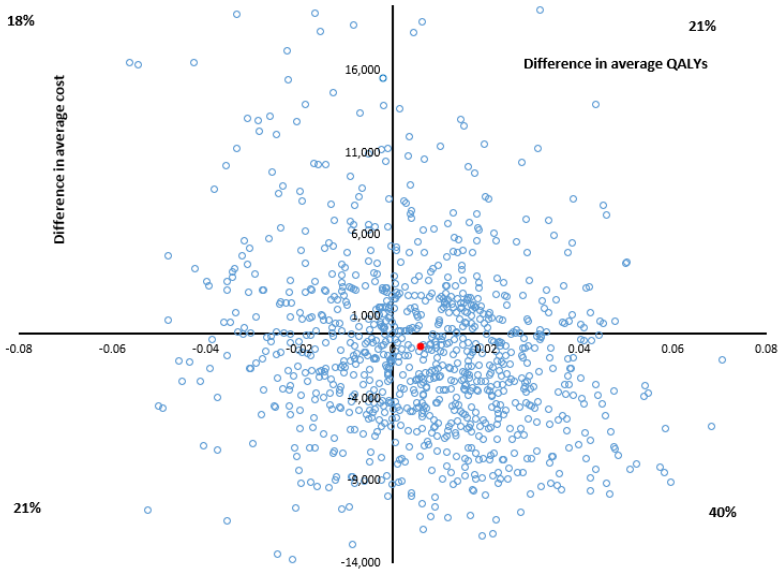
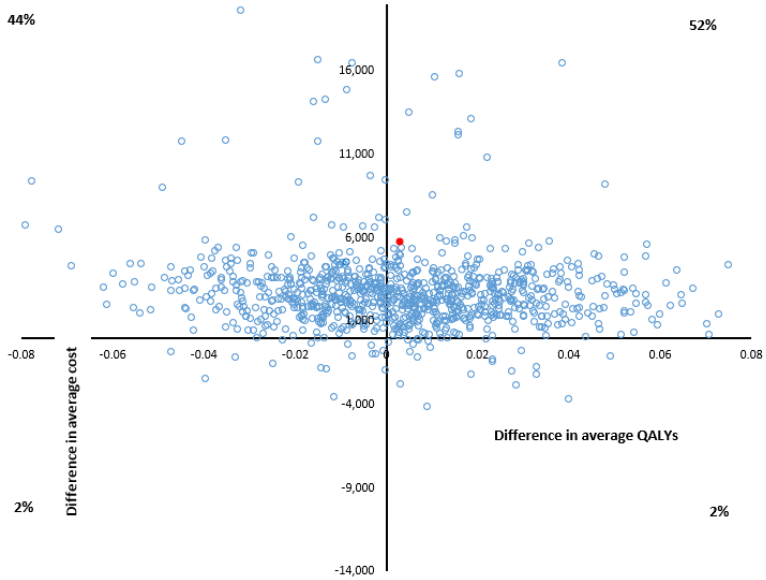


Figure 6. Cost-effectiveness plane, in Australian dollars (Aus $1=US $0.7058), for group 2 versus group 3 cost per quality-adjusted life year (QALY) bootstrapped from complete cases.



Sensitivity Analyses

The results for the comparison of group 2 with the control group were generally robust in the sensitivity analyses as shown in Table 5. The exception was multiple imputation that led to a nonsignificant negative mean difference in QALYs between group 2 and group 1 (control). The probability that the group 2 intervention would be cost-effective compared with the control group at the willingness-to-pay threshold of Aus $50,000 per QALY in the complete case analysis was estimated at 63% (Figure S2 in Multimedia Appendix 1).

The intervention cost of group 2 was also varied to assess the threshold when the mean cost difference between group 2 and group 1 would become positive. This occurred when the group 2 intervention cost was Aus $4500.

The sensitivity analyses for the comparison of group 3 with group 1 (control) were mostly consistent with the base case (Table 5). The analysis using multiple imputation led to negative incremental cost and QALY differences, both being nonsignificant, but leading to a positive incremental ICER. Across all sensitivity analyses, the probability of group 3 being cost-effective compared with group 1 (control) at the threshold of Aus $50,000 per QALY was ≤54% (Figure S3 in Multimedia Appendix 1).

The sensitivity analyses for the comparison of group 2 and group 3 were mixed. The complete case and multiple imputation analyses led to positive mean differences in QALYs and positive ICERs. The probability of group 3 being cost-effective compared with group 2 at the threshold of Aus $50,000 per QALY was ≤22% across all sensitivity analyses (Figure S4 in Multimedia Appendix 1).

Using the costs of the group 2 and group 3 interventions, if implemented across the population of people with BD in Australia (Table S7 in Multimedia Appendix 1), led to marginally lower mean differences in costs, which did not substantially change the ICERs.

Table 5. Sensitivity analyses, in Australian dollars (Aus $1=US $0.7058), on incremental cost-utility ratios by randomized group.

	Health care costs, mean difference (95% CI)	QALY[a], mean difference (95% CI)	Cost per QALY, ICER[b] (95% CI)
Comparison of group 2 vs group 1 (control)			
Mixed effects model (base case)	–2858 (–10,909 to 5194)	0.012 (–0.009 to 0.033)	Dominant (43,000 to dominant)[c]
Complete case	–6164 (–12,435 to 108)	0.000 (–0.035 to 0.035)	Dominant (43,000 to dominant)[c]
Multiple imputation	–2277 (–6568 to 2023)	–0.001 (–0.023 to 0.021)	2,277,000 (19,465 to dominant)
Population-level intervention costs	–3081 (–11,132 to 4970)	0.012 (–0.009 to 0.033)	Dominant (33,370 to dominant)[c]
Comparison of group 3 vs group 1 (control)			
Mixed effects model (base case)	–94 (–9422 to 9235)	0.002 (–0.023 to 0.027)	Dominant (dominated to 19,978)[d]
Complete case	–2826 (–10,168 to 4516)	0.005 (–0.032 to 0.042)	Dominant (dominated to 19,978)[cd]
Multiple imputation	–831 (–6943 to 5808)	–0.003 (–0.027 to –0.022)	257,361 (dominated to 35,982)
Population-level intervention costs	–386 (–9714 to 8943)	0.002 (–0.023 to 0.027)	Dominant (dominated to 18,559)[cd]
Comparison of group 2 vs group 3			
Mixed effects model (base case)	7798 (–2303 to 17,900)	–0.004 (–0.028 to 0.021)	Dominated (dominated to 21,287)
Complete case	3338 (–2072 to 8748)	0.005 (–0.033 to 0.043)	667,600 (dominated to 21,287)
Multiple imputation	2527 (–3415 to 8469)	0.002 (–0.022 to 0.026)	1,263,500 (dominant to 14,129)
Population-level intervention costs	7729 (–2372 to 17,831)	–0.004 (–0.028 to 0.021)	Dominated (dominant to 16,283)

[a]QALY: quality-adjusted life year.

[b]ICER: incremental cost-effectiveness ratio.

[c]Complete case bootstrap CIs were used for both mixed effects model and complete case analyses.

[d]The results are spread across all 4 quadrants of the cost-effectiveness plane, making the CI difficult to interpret.

Discussion

Principal Findings

To our knowledge, this is the first economic evaluation of an internet-based psychoeducation and CBT intervention specific to people with a diagnosis of BD [18,41]. The results suggest that the psychoeducation offered to group 2 through the MoodSwings 2.0 website may be cost-effective compared with an active control group of a moderated internet-based discussion board for people with a diagnosis of BD. The results also suggest that the addition of CBT tools to the psychoeducation component was not cost-effective compared with the moderated internet-based discussion board alone or the combination of psychoeducation plus the moderated internet-based discussion board.

The difference in cost between the participants randomized to the internet-based psychoeducation and the control condition (internet-based forum only), although not significantly different, showed a trend favoring internet-based psychoeducation. This was attributed to lower costs for acute care services such as hospitalizations and emergency room visits. These results are similar to those of research evaluating the costs and outcomes associated with an in-person 21-session group psychoeducation program for people with BD [42]. Over 5 years of follow-up, participants receiving the group psychoeducation had significantly fewer days hospitalized, which led to nonsignificant lower total costs for the psychoeducation group. Our results contrast with another trial-based cost-effectiveness analysis of an in-person 21-session structured group psychoeducation program that found significantly higher total costs and additional QALY gains for the participants receiving group psychoeducation compared with those receiving unstructured group peer support [43].

The MoodSwings 2.0 study group randomized to the psychoeducation modules showed statistically significant

improvements in depression symptoms, as measured by MADRS scores, compared with the control group. These differences were also clinically meaningful, falling within the range of estimated minimal important difference of 3 to 6 points for the MADRS [44]. This is similar to results from the study by Lam et al [45] that found significantly improved scores on the Beck Depression Inventory at 4 and 6 months for the group receiving cognitive therapy versus a control group. The resulting average ICER for the psychoeducation intervention compared with the control group was dominant, meaning that there was improvement in MADRS scores at a cost savings.

Cost-effectiveness ratios such as cost per point change in MADRS score are difficult to interpret because of a lack of value attached to a point change in MADRS score. QALYs have inherent value-for-money connotations because of generally accepted willingness-to-pay thresholds used by health technology assessment agencies such as the United Kingdom's National Institute for Health and Care Excellence and Australia's Medicare Services Advisory Committee.

We did not find significant differences in utility values or QALYs among the groups over the 12-month follow-up. This contrasts with a small significant QALY gain of 0.023 (95% CI 0.001-0.56) associated with a previously evaluated in-person group psychoeducation intervention compared with in-person group peer support [43]. This may be due to the in-person mode of delivery, a longer follow-up of 96 months, use of the EQ-5D instrument, and lower rates of loss to follow-up.

Our results further suggest that the combination of psychoeducation and CBT tools (group 3) would not be considered cost-effective compared with the moderated internet-based discussion board (group 1) based on the cost-utility results. Group 3 had a trend toward lower costs and more QALYs compared with the control group, but there was a great deal of uncertainty around this dominant average cost per QALY ratio, resulting in a 51% probability of being cost-effective at the threshold of Aus $50,000 per QALY generally accepted as value for money in Australia. These results are comparable to economic evaluations of other unguided internet-based CBT interventions evaluated in people with unipolar depression [46,47].

The combination of internet-based psychoeducation and CBT tools (group 3) would not be considered good value for money compared with internet-based psychoeducation (group 2) based on the dominated average cost-utility ratio. The combination of internet-based psychoeducation and CBT tools (group 3) resulted in an average cost-effectiveness ratio of Aus $11,140 per point improvement in MADRS compared with internet-based psychoeducation (group 2). Although this seems favorable, it is harder to interpret because we do not have a willingness-to-pay threshold for a point improvement in depression symptom scores.

A prior evaluation of the MoodSwings 2.0 program found within-group improvements in depression and mania symptoms, medication adherence, and quality of life for participants receiving psychoeducation alone and psychoeducation plus CBT-based interactive elements [26]. The lack of an attention control group may explain the difference in findings compared with our evaluation.

Limitations

As with all research, the results of this economic evaluation are subject to limitations. There was a high rate of loss to follow-up over the 12 months of the study period and a higher likelihood of missing cost and utility data for female participants, which may affect the validity of the results. The cost-effectiveness and cost-utility analyses would only be generalizable to the Australian context because of the exclusive use of Australian unit costs. The analytic approach followed published recommendations for the management of missing data. However, the complete case and multiple imputation results differed from the base case for the comparison of group 2 with group 3 as well as multiple imputation results differing from the base case for the comparison of group 3 with group 1 (control). There was also no treatment-as-usual control arm. The cost of programming and delivering the internet-based interventions was estimated based on the available information for this trial but may have been higher because of additional time for programming and system maintenance not captured in our projected costs. However, we found that the average total cost was lower for group 2 than for group 1 (control) until the intervention cost reached Aus $4500 per study participant, which is 7 times higher than the Aus $645 base case intervention cost for group 2.

Despite this evaluation's limitations, it is important to report the results of economic evaluations of internet interventions aimed at supporting people with BD. Overall, there is limited literature on the cost-effectiveness of psychosocial interventions for the treatment of BD and none for BD-specific digital interventions [18,31]. People with BD are a unique population because of the symptomatology, medications, and behavioral aspects related to the diagnosis. Psychosocial interventions designed for other mental health conditions (ie, unipolar depression and anxiety) may not be appropriate to extrapolate to people with BD. It is important to tailor the information to the specific issues related to this diagnosis and evaluate program effectiveness and cost-effectiveness.

The availability of internet-based interventions is crucial, given lack of access to mental health professionals because of limited availability, geographic location, and, recently, public health measures related to COVID-19 infection control. The Australian Productivity Commission's Inquiry Into Mental Health report recommended a national digital mental health platform with a gateway to digital and face-to-face treatment and support services. Any interventions provided through this mental health gateway should have evidence of, or at a minimum be concurrently evaluated for, their effectiveness and cost-effectiveness.

Conclusions

The internet-based psychoeducation provided through the MoodSwings 2.0 platform to the group 2 participants has the potential to be a cost-effective intervention for people diagnosed with BD. The group 2 psychoeducation component could be further evaluated in an implementation study for effectiveness

and cost-effectiveness. Additional research is needed to understand the lack of effectiveness for the internet-based CBT tools provided as part of the group 3 intervention.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Supplementary materials.
[DOCX File , 803 KB - mental_v9i11e36496_app1.docx]

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Abbreviations

BD: bipolar disorder
CBT: cognitive behavioral therapy
GLM: generalized linear model
ICER: incremental cost-effectiveness ratio
MADRS: Montgomery-Åsberg Depression Rating Scale
QALY: quality-adjusted life year
RCT: randomized controlled trial
SF-12: short-form health survey, 12-item version
SF-6D: short-form 6-dimension

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Viewpoint

Ethical Implications of the Use of Language Analysis Technologies for the Diagnosis and Prediction of Psychiatric Disorders

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Abstract

Recent developments in artificial intelligence technologies have come to a point where machine learning algorithms can infer mental status based on someone's photos and texts posted on social media. More than that, these algorithms are able to predict, with a reasonable degree of accuracy, future mental illness. They potentially represent an important advance in mental health care for preventive and early diagnosis initiatives, and for aiding professionals in the follow-up and prognosis of their patients. However, important issues call for major caution in the use of such technologies, namely, privacy and the stigma related to mental disorders. In this paper, we discuss the bioethical implications of using such technologies to diagnose and predict future mental illness, given the current scenario of swiftly growing technologies that analyze human language and the online availability of personal information given by social media. We also suggest future directions to be taken to minimize the misuse of such important technologies.

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KEYWORDS

at-risk mental state; psychosis; clinical high risk; digital phenotyping; machine learning; artificial intelligence; natural language processing

Introduction

In 2018, football commentator and former Liverpool defender Mark Lawrenson was alerted to a facial cancerous blemish by one of his viewers [1]. General practitioner Alan Brennan emailed England's BBC and alerted Lawrenson after watching him on TV and spotting the suspicious skin lesion. Lawrenson successfully treated the skin cancer and later would bring the doctor to the TV show to interview and thank him. In 2020, reporter Victoria Price was on air when a spectator noticed a lump on her neck [2]. The woman promptly emailed the reporter alerting that Price should have her thyroid checked—the spectator reported she also had a neck bulging in the past that was revealed to be cancer. After exams and appointments with oncologists, Price confirmed that the lump was a thyroid cancer

and underwent an effective treatment [2]. These are two examples among many others in which signs of someone's undiagnosed disease could be noticed by a third party who seized the opportunity to alert the person about it. Such attitudes are often lifesaving, as they end up in diagnosis and effective treatment. However, what if mental illness could somehow also become perceptible?

In this paper, we discuss the intrinsic privacy protection of mental illnesses and how current technologies, specifically artificial intelligence (AI), allow us to "see" mental illness and potentially bypass this protection. By "see," we mean to view by digital means. Stigma is then addressed, as it is the main issue that makes the ability to "see" mental illness have different consequences as compared to "seeing" other illnesses. Bioethical issues related to both previous items and to the use of such technologies are discussed. We then address the interpretability of AI models, an issue that may threaten bioethical principles. Lastly, we discuss problems related to the use of such technologies outside clinical and research settings.

The Privacy Protection of Mental Illness

We usually think of psychiatric illness as having an intrinsic privacy protection, since we need someone to talk about their thoughts and feelings to make a mental status assessment. However, many psychiatric disorders are somewhat apparent to the trained eye—and ears—of the mental health professional and even to lay people. Appearance and behavior are the first items in the mental status examination, a road map for mental health professionals that is equivalent to the physical exam of the general practitioner [3]. Along this examination, the content and form of what someone says is also carefully assessed, as speech is the main access we have to the patient's thoughts and feelings. These are all items of what we denote in a broad definition as communication: the first is called nonverbal communication (or nonverbal language), and the other is verbal communication [4]. Therefore, the way someone behaves and what someone says, even while not being in a psychiatric interview, can sometimes provide enough data to presume the possibility of a mental disorder. This is similar to the case with jaundice, weight loss, or lumps across the body in other illnesses, for instance. However, confirmation of the diagnosis is dependent upon further examination beyond the signs shown. This confirmation, as well as the disclosure of the diagnosis, is contingent on the patient's acquiescence to be submitted to laboratory tests, imaging, and physical examination, and to reveal their feelings and experiences by further questioning about their mental status during an interview. Nevertheless, this "privacy protection" might be overcome by technology and by the quick and recent progress in AI modeling.

To begin with, the wide use of social media has made an unprecedented amount of private data publicly available. This is not a novel issue, as it has been addressed in movies and publications in diverse fields [5,6], and was recently put in the spotlight of public debate as a consequence of privacy lawsuits against the big information technology corporations [7]. While the use of such personal big data for profiting purposes has been unveiled, its use for mental health purposes remain largely unknown. People share images, videos, and texts on their social media, showing how they behave and what they speak and think. These are the very tools used by mental health professionals to make their diagnosis. Evidently the issues displayed in social media are not the ones investigated in a mental health consultation, but they often overlap as users frequently post their intimate feelings, share their mood, and so on, online. Besides this, AI techniques have evolved to an extraordinary level, and their machine learning (ML) algorithms for verbal and nonverbal language analyses of individuals has evolved likewise [8,9]. A study published in 2020 used language and images posted to Facebook to identify signs associated with psychiatric illness [10]. A ML algorithm was fed with 3,404,959 Facebook messages and 142,390 images across 223 participants with schizophrenia spectrum disorder or mood disorders and healthy volunteers. All data prior to the first psychiatric hospitalization was uploaded to minimize the potential confounds on social media activity of medications, hospitalizations, and relapses, and receiving a formal psychiatric diagnosis. The algorithm was able to differentiate the diagnosis using Facebook activity alone over a year in advance of the first-episode hospitalization, with areas under the curve (AUCs) varying between 0.72-0.77.

Regarding this "visibility" of severe mental disorders, in more clinical/research settings, video diagnosis frameworks have also been tested, with encouraging results. Researchers have found that neuromotor precursors of schizophrenia, for instance, can be traced back to childhood [11]. Accordingly, an analysis of brief videotape footage of children eating lunch suggested that observed movement anomalies were able to discriminate among those children who later developed schizophrenia and those who did not [12]. More recently, verbal language features extracted from video and audio recordings were shown to be important early signs of psychotic illness [13-17]. These features include discourse coherence, syntactic complexity, speech content poverty, metaphorical language, and language structural connectedness [13-17]. Bedi et al [13], for instance, showed that discourse coherence was significantly correlated with subclinical psychotic symptoms. Though derived from a small sample of individuals with at-risk mental states (ARMSs) for psychosis, their model could predict with 100% accuracy progression from the risk state to schizophrenia. This finding of lower speech connectedness in at-risk individuals was also replicated by Spencer et al [17], who used speech graphs in their analyses, another technique to assess syntactic complexity and speech content poverty. These features are commonly referred to as natural language processing and, in larger samples, were used to obtain AUCs as high as 0.88 for predicting which at-risk individuals will develop a psychotic disorder in the future. For individuals at first-episode psychosis, AUCs of up to 0.92 were obtained to predict who would receive the diagnosis of schizophrenia 6 months in advance [16]. Audio features such as pauses [18] and nonverbal behavior such as gestures [19] and movement in general [20] were also seen to be discriminative between healthy and ARMSs. Besides serious mental disorders [21], AI frameworks have also been developed to detect and classify other mental disorders, as shown by numerous publications and challenges to establish an accurate

depression estimation from audio, video, and text information [22,23].

Thus, the possibility to "see" mental disorders is, per se, an innovative technology. It could increase access to mental health care and allow for prevention, early diagnosis, and treatment, as in the cases of the illnesses cited in the beginning of this text. It could also aid clinicians in diagnosing, following-up, and prognosing their patients in their daily practice. This would greatly improve the outcome and quality of life for those afflicted with a mental illness. However, one issue distinguishes mental disorders from other illnesses, making the idea of "seeing" them less desirable. This issue is stigma.

Stigma of Mental Illness

Mental illness carries a great deal of social stigma, which most physical illnesses do not [24]. Prejudice and discrimination toward people with mental disorders is historical, existing from before the birth of psychiatry [25,26]. Unfortunately, despite the great advances seen in psychiatry in the last decades, stigma still persists in several forms [27]. Its causes are many, but as mental disorders generate behavioral changes, they often tend to be judged by the public as a moral act of the patient. If one conceives mental illness as a strictly biological disease, with genetic causes, for instance, fear and feelings of insecurity arise toward the mentally ill, as if the person would not have control of their actions [28]. If mental illness is conceived as a sole psychosocial issue, the patients are to blame for their depressive symptoms, anxiety, and so on. The situation is worse for the group of severe mental disorders. Hallucinations and delusions seen in schizophrenia symbolize a mismatch of people with the disorder with the public's common experience, generating fear, perceived danger, and the desire for social distancing [29-31].

As such, stigma constitutes a major treatment barrier for those with mental disorders, hampering preventative initiatives and substantially worsening outcomes. This barrier appears before treatment has begun (low mental health literacy, stereotypes endorsement, and diagnosis delay and denial) and continues thereafter (self-stigma, low treatment adherence, diagnosis disclosure) [32]. Stigma also contaminates those that surround the mentally ill, including family members, friends, and health professionals. Reproducing the prejudice seen in other illnesses such as AIDS and leprosy in the past, mental disorders are often faced as if they were contagious [33]. This worsens discrimination and social isolation as even close people tend to stay away from those with the diagnosis—something called courtesy stigma [34,35]. Due to this multifaceted burden of stigma, revealing that someone may have a depressive disorder, or that someone may be at risk of having schizophrenia in the future, is different from pointing out that someone should seek a doctor because of a suspected thyroid or skin cancer [36].

To make the stigma issue worse, there is the problem of false positives [37]. There is an ongoing debate on the accuracy of one of the most studied preventive paradigms in psychiatry, namely, the ARMS for psychosis concept (or clinical high risk for psychosis) [38]. Researchers are trying to enhance the accuracy of the ARMS criteria, as studies showed that most individuals that fall into the criteria (76%) do not develop a psychotic disorder at all [39]. In other words, the use of ARMS criteria alone generates a large number of false positives. The use of language to classify ARMS individuals who will develop a future disorder can potentially predict up to 80%-90% of cases, as seen in some studies—though with small samples. This accuracy is similar to that of a pap smear to screen for cervical cancer, eliciting a false-positive rate of around 20% [40]. However, while pap smears are routinely used as an important preventive public health strategy and concerns are directed toward improving the false-*negative* ratio [41], "seeing" severe mental disorders through language analysis would still be a concern. Even though language frameworks can substantially reduce the number of false positives, the great stigma related to the condition and the uncertainty regarding intervention at this phase still hinder the implementation of preventive strategies. As such, the number of prevented cases must be weighed against the number of individuals harmed by being misdiagnosed as being at risk [42].

Bioethical Issues

Given that mental disorders might be now "visible" to AI algorithms that analyze communication, and that there is a stigma related to these disorders, one must consider the bioethical implications. The four main principles of bioethics are (1) beneficence, (2) nonmaleficence, (3) autonomy, and (4) justice [43].

Beneficence is the principle that guides physicians to act for the benefit of patients. It also implies several other actions beyond the usual patient-doctor relationship in a clinic, such as rescuing persons in danger, removing conditions that will cause harm, and helping individuals with a disability. Beneficence is a positive concept in the sense that one has to be active, to propose actions and intervene. Nonmaleficence, on the other hand, concerns the obligation physicians have to not harm their patients, not worsen their health, not incapacitate, not cause suffering, and not deprive others of the goods of life. In practice this implicates the weighting of benefits against burdens of all interventions and treatments and in considering not to act [43]. Autonomy asserts that every person has the power to make rational decisions and moral choices, and everybody should be allowed to exercise their capacity for self-determination. The principle of autonomy branches out into three other important principles [43]:

1. Informed consent: patients must receive full disclosure and comprehend the disclosure to voluntarily agree to a medical procedure or research.
2. Truth-telling: a vital component in a physician-patient relationship, as autonomous patients have the right to know their diagnosis but also the option to forgo this disclosure.
3. Confidentiality: physicians are obliged not to disclose any confidential information given by patients to another party without their consent.

Justice is the fourth ethical principle. It encompasses the need for a fair, equitable and appropriate treatment of persons. This principle may encompass microsettings, such as adequately treating individuals in an emergency service, as well as macrosettings involving health care policies.

That being said, the use of language detection algorithms for mental health purposes may pose some bioethical dilemmas, and the use of such tools must still be approached with caution. The role of medical advice and diagnosis in one's disease trajectory is relevant, and the early detection of mental illness can enable health care practitioners to intervene and avoid negative outcomes. On the other hand, the attribution of labels can also increase the chances of self-stigma [42]. Social stigma is a great burden for people with mental disorders and is especially associated with the psychiatric diagnosis (ie, labels) [29], generating poorer outcomes and other negative consequences [44]. This is especially important considering the high rate of false positives among the previously cited ARMS condition [39]. That is, individuals (wrongly) classified as ARMS but who would never develop a mental disorder. Using the ARMS paradigm indiscriminately to diagnose individuals without properly demystifying this information and destigmatizing mental illnesses would constitute a threat to the nonmaleficence principle [42]. Besides, it would also be potentially paternalistic, harming autonomy.

To understand the biological pathways toward psychosis and to develop new treatments, research efforts are being directed to the enhancement of the predictive power of the ARMS concept [45]. This is being done by investigating biological markers or by using ML algorithms. In this sense, the use of AI for natural language processing has produced encouraging results, with a diagnostic accuracy similar or superior to other classifiers used in medicine [14,15]. However, if stigma is not addressed in a comprehensive way, no matter how few false positives there are, they will still be a concern regarding nonmaleficence. Moreover, the use of such algorithms to interpret language data also poses a threat to nonmaleficence and to autonomy, more specifically concerning the lack of comprehension of certain information given by such algorithms, which we depict below.

Interpretability and Validity of Algorithms

The issue that some ML models are impossible to interpret has recently gained a growing interest [46]. There's an ongoing discussion on the repercussions of such algorithms for high-stakes decisions. Such models are called black box models, for their operation with the inputted variables is not completely observable. They are known to learn from subtle metadata, and this may carry the risk of hidden bias (eg, the Clever Hans problem) [47].

Exemplifying this, in 2018, a study aimed to investigate the generalizability across sites of a deep learning model to detect pneumonia in chest radiographs [48]. At first, the model performed very well in distinguishing high-risk patients from non–high-risk patients. However, upon external validation, the performance plummeted. The AI model was not learning from clinically relevant information from the images. Instead, it was learning and basing its decisions on hardware-related metadata tied to a specific x-ray machine. This machine was being used in an intensive care unit (ICU) to image mostly high-risk individuals [49]. That is, the algorithm would attribute a high-risk classification to most images coming from that ICU's x-ray, instead of using clinical data from the x-rays themselves to make decisions. Several scholars have discussed explainability as a major problem for the use of AI in health care [50].

For some computational problems, it is hard to associate meaningful parameters with individual variables. For instance, in images examined by computer vision, each pixel is meaningless without context, while the full set of pixels taken together contain local (eg, pixels that together form a smile) and global (eg, sources of light inferred from shadow directions) characteristics. Complex models make use of several heuristics to capture abstract notions according to each application. Concepts such as objects in pictures and seasonality in time series are encoded and distributed across different structures within the model. Therefore, simple descriptions such as "anxiety increases as stress increases" are rarely possible, contrary to what happens in familiar regression methods. Since multiple conditional dependencies preclude direct statements about results, additional analytical and experimental steps are required for the interpretation of complex models [51].

In short, it is not enough only to enhance predictive power and avoid false positives but also to understand the real-world underpinnings of black box algorithms [49]. Both machine statements and human statements are congruent with a given ground truth [50]. Taking the above example, we have two statements, accordingly. First, a specific characteristic of some given x-rays is associated with a higher risk for pneumonia (machine statement). Second, we should prioritize patients with those x-rays, as they are at higher odds of having pneumonia according to the ML model (human statement). Both statements are equally used for decision-making. Nevertheless, human models are often based on causality as an aim for understanding underlying mechanisms and for intervention. While the correlation is accepted as a basis for decisions, it is viewed as an intermediate step. For instance, *why* are those specific patients at higher risk of having pneumonia? We should investigate their characteristics to understand the higher risk of pneumonia and to develop a specific antibiotic. On the other hand, ML algorithms are typically based on probabilistic models and provide only a crude basis for further establishing causal relationships. Upon opening the black box, the relationship between that specific set of x-rays and pneumonia was due to a given x-ray machine located in an ICU service that was working on many more cases of pneumonia than the other machines. That is, ML models offer important decision-making tools, namely, prioritizing those individuals. However, further investigations beyond the simple association should be conducted, opening the black box and addressing physiopathological explainability and causability.

Decisions in health care imply liability, including legal and financial repercussions. Therefore, each decision must be logically reasoned with explainable evidence [49]. AI models might be insightful for scientists, but they should also be sufficiently clear and explainable for end users to support their decisions [52]. Otherwise, it could constitute a threat to the patient's autonomy. Accordingly, traditional algorithms must handle sources of information in an interpretable manner, such as the GRACE score for acute coronary syndrome and the

Sequential Organ Failure Assessment score for organ failure in ICUs [53,54]. They map higher probabilities of a bad outcome to signs of severity (eg, abnormal values in biological markers). Clinical support decision systems based on opaque ("black-box") algorithms must, as such, provide a clear rationale to be useful for practitioners. Besides carrying hidden bias, the use of opaque algorithms leads to a defensive medical practice. When no underlying rationale is presented [55], physicians tend to agree with the machine to avoid liability. On the other hand, interpretable outputs will help practitioners to treat their patients with fewer overlooked findings and misled predictions.

Post hoc techniques of analysis (local interpretable model-agnostic explanations, Shapley Additive Explanations, multilingual unsupervised and supervised embeddings, etc) are an option when model parameters are numerous and computational processes go beyond elementary functions and operators [51]. Specifically regarding language data, researchers should treat findings from computer based evaluations as they do with traditional indicators. It is crucial, for instance, to have representative data as a basis for normative curves for each proposed behavioral marker. How does it develop through ages; how does it change according to gender or ethnicity; what are the effects of social factors such as socioeconomic status, educational level, neighborhood, or exposure to urban violence? Before jumping to the conclusion on the relationship of some behavioral marker to a pathological factor, we first need to map and understand normative variability across cultures, languages, and countries [56,57]. For example, language structural connectedness that diminishes according to negative symptom severity under psychosis [16] also increases during typical development, being tightly associated with educational levels. Years of formal education are more important to explain this developmental trajectory than years of age to the point that illiterate adults narrate their stories with a structural pattern similar to preschool children [58].

After gaining insights on potential pathological markers and mapping on pathological confounding factors, we still need to discuss potential public policies that protect the individual rights to not be evaluated or even judged without consent.

Legislation and Data Privacy

Otto Hahn won the Nobel Prize for discovering nuclear fission in 1939 and allowing nuclear reactors to produce enormous amounts of energy [59]. However, he is a controversial historical figure once his discovery also allowed the building of the World War II atomic bombs. Arthur W Galston studied the effects of 2,3,5-triiodobenzoic acid on the growth and flowering of soybeans. Later the military developed it into Agent Orange and used it in the Vietnam War as a chemical weapon. This led Galston to become a bioethicist and give talks on the misuse of science [60]. Likewise, internet, smartphones, social media, and search mechanisms revolutionized our relationship with knowledge and with each other as humans. However, unethical misuse of big data to control one's exposure to information, to stimulate consumerism, and to capture someone's time for profiting purposes are the proxies of such inventions' perversion [61]. The number of discoveries—either scientific or not—that got misused by third parties other than their inventor is countless. It is easy to figure out how technologies that address mental status through language can follow the same way.

Automated analysis of free speech, for instance, can establish thought disorder indexes based on what someone says or writes [13]. Additionally, these indexes can predict future serious mental disorders like schizophrenia. That is, the data fed into the analysis can be extracted from written text from books, transcripts, or other data sets that are available to the public (eg, social media or personal blogs). This raises the possibility of malicious use, given the online availability of people's written data on the internet. Another example of the possible use of available information to infer the mental status of individuals is the Facebook study mentioned at the beginning. The algorithm could predict a future and severe mental disorder with a 72%-77% level of certainty. All these works importantly advance science and provide the perspective of useful tools to be used by clinicians and policy makers. Additionally these findings are developed in environments strictly guided by ethical standards given by ethics committees and supervised by the scientific community. However, the problem is not related to these regulated settings but when the invention goes beyond scientists.

Likewise, ethical boards review and regulate scientific studies and health professionals' practice; apart from these settings, the law exists to oversee and penalize irregular use of big data [62]. As such, there is now a growing concern about digital privacy, especially after the awareness raised by the lawsuits against big tech claiming too much power over people's lives and personal information a few years ago. This has led to an increase in legislation to regulate access and use of personal information, especially that which is somewhat publicly available in online social networks. However, there is always the risk of a legal gap as cutting-edge inventions are temporally ahead of legislation protecting them from misuse. This is especially evident today as new ML algorithms and technologies arise with increasing frequency. This can potentially foster discrimination of individuals with mental disorders in countries where such a gap is not covered by personal information privacy protection legislation. For instance, allowing the misuse of such technologies in job interviews, academic interviews, and so on, to dismiss people from the selection process based on preconceived ideas about mental disorders.

Conclusion

Summarizing, new technologies derived from AI have the potential to "see" mental disorders by someone's behavior and discourse. These technologies per se would greatly help in early detection and disease outcome. However, the historical and enduring stigma attached to mental disorders hampers the use of such tools. Fighting prejudice and discrimination related to mental disorders should constitute future directions so that stigma does not constitute a barrier for the use of these innovative technologies. Moreover, to comply with nonmaleficence and avoid the stigma, these technologies also need to have low rates of false positives in predicting someone's possibility of future mental illness. There is a further risk that

these ML algorithms turn into black box models. This hidden bias problem could potentially harm the patients' autonomy and disclosure. So, it is necessary to clearly describe the algorithm, to use post hoc interpretation methods, and to conduct bias-checking procedures. Additionally, because of stigma and due to the high online availability of personal information on an individual's verbal and nonverbal language, information derived from the algorithms carries the risk of being misused, such as to discriminate against individuals because of their mental health status. In this sense, awareness should be raised in regulating the use of these technologies in real-world settings. There is a challenge for legislators to catch-up with the ever-renovating new technologies and algorithms designed to decipher human behavior to prevent these inventions from being misused.

Conflicts of Interest

NBM works at the Motrix, an EduTech startup, and has been a consultant to Boehringer Ingelheim. The other authors have no conflicts of interest to declare.

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Abbreviations

AI: artificial intelligence

ARMS: at-risk mental state
AUC: area under the curve
ICU: intensive care unit
ML: machine learning

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Original Paper

Positive Affective Recovery in Daily Life as a Momentary Mechanism Across Subclinical and Clinical Stages of Mental Disorder: Experience Sampling Study

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Abstract

Background: Identifying momentary risk and protective mechanisms may enhance our understanding and treatment of mental disorders. Affective stress reactivity is one mechanism that has been reported to be altered in individuals with early and later stages of mental disorder. Additionally, initial evidence suggests individuals with early and enduring psychosis may have an extended recovery period of negative affect in response to daily stressors (ie, a longer duration until affect reaches baseline levels after stress), but evidence on positive affective recovery as a putative protective mechanism remains limited.

Objective: This study aimed to investigate trajectories of positive affect in response to stress across the continuum of mental disorder in a transdiagnostic sample.

Methods: Using the Experience Sampling Method, minor activity-, event-, and overall stress and positive affect were assessed 10 times a day, with time points approximately 90 minutes apart on six consecutive days in a pooled data set including 367 individuals with a mental disorder, 217 individuals at risk for a severe mental disorder, and 227 controls. Multilevel analysis and linear contrasts were used to investigate trajectories of positive affect within and between groups.

Results: Baseline positive affect differed across groups, and we observed stress reactivity in positive affect within each group. We found evidence for positive affective recovery after reporting activity- or overall stress within each group. While controls recovered to baseline positive affect about 90 minutes after stress, patients and at-risk individuals required about 180 minutes to recover. However, between-group differences in the affective recovery period fell short of significance (all $P>.05$).

Conclusions: The results provide first evidence that positive affective recovery may be relevant within transdiagnostic subclinical and clinical stages of mental disorder, suggesting that it may be a potential target for mobile health interventions fostering resilience in daily life.

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KEYWORDS

experience sampling methodology; ecological momentary assessment; trajectory; transdiagnostic; resilience; stress reactivity; psychosis; depression

Introduction

When developing a mental disorder, an individual is commonly assumed to experience a state in which psychological distress and symptoms gradually increase without fully meeting diagnostic criteria [1,2]. Corresponding to staging models in general medicine, the concept of clinical staging in psychiatry broadens the dichotomous definition of mental health versus ill-health by placing an individual on a continuum that defines thresholds for different stages of mental disorders [3-5]. Especially the identification of early stages of mental disorder marked by psychometric and familial risk criteria has received increasing attention as a potential target group for early intervention and prevention programs [4,6]. Psychometric risk states can be characterized by nonspecific distress and attenuated symptoms that are not disorder specific, thereby implying a transdiagnostic perspective on early stages of mental disorders [4,6,7]. In addition, there is evidence for an increased familial liability to severe mental disorders, such as psychosis [8] and major depression [9,10], suggesting that even relatives without a formal diagnosis of a disorder can be placed closer toward clinical thresholds on the continuum of mental health.

There is consistent evidence on high comorbidity in at-risk individuals, which has been taken to suggest a pluripotent risk state or early shared mechanisms, from which individuals may transition to different, more specific exit syndromes of severe mental disorder, for example, psychotic or affective disorders [1,3,11]. One common underlying mechanism that has been proposed is behavioral sensitization. Specifically, it has been posited that, in individuals exposed to severe and repeated adversity across the life course, the stress response is gradually amplified such that they eventually show a strong response to even minor stressors in daily life [12], which may, in turn, be associated with a greater risk of transitioning to mental disorder. The most commonly used behavioral marker of stress sensitization is elevated stress reactivity, characterized by strong emotional reactions to minor stressors in daily life (eg, [12-15]), measured with experience sampling methodology (ESM), an intensive longitudinal diary technique [16]. Indeed, stress reactivity has been found to be elevated in individuals with an increased risk for [17,18] and a diagnosis of severe mental disorder [13,15,17]. Furthermore, there is evidence pointing toward stress reactivity measured in experience sampling studies being more pronounced in at-risk individuals than in patients [13,18-20].

Focusing on underlying mechanisms, experience sampling studies have emphasized the importance of investigating risk and resilience mechanisms when studying transdiagnostic and subclinical samples in daily life [21,22]. Resilience has been defined as the ability to recover from the effects of significant adversity [23,24]. Translating this definition to the realm of momentary mechanisms measured with experience sampling, it is tempting to speculate whether momentary resilience may be reflected in the ability to recover, in the moment, from minor stressors and adverse experiences in daily life.

So far, research into momentary mechanisms has focused on negative affect. There is initial evidence that individuals with early mental health problems may experience extended momentary negative affective recovery from minor stressors in daily life, that is, they take longer to overcome minor adversities in daily life [20]. Indeed, positive affect has been proposed as an important building block of resilience [25,26] that can be relevant when recovering from negative experiences [24,27]. Importantly, patients (see [28]), but also individuals at-risk for mental disorder (eg, [29,30]), have been shown to be less sensitive to positive stimuli and may have a reduced ability to experience positive emotions overall (ie, anhedonia), suggesting that they may potentially show different trajectories of positive affect after experiencing stressors.

Against this background, this study aimed to investigate trajectories of momentary positive affect following exposure to minor stressors in daily life across transdiagnostic stages of mental disorder in a pooled sample of patients with a mental disorder (ie, psychotic disorder, depressive disorder with residual symptoms), individuals with an increased psychometric or familial risk for developing a severe mental disorder, and controls. To examine, in detail, the entire positive affective recovery process from minor stressors through to recovery to baseline levels, we aimed to investigate (1) levels of positive affect prior to reporting a minor daily stressor; (2) initial positive affective reactivity following the stressor—operationalized as the decrease in positive affect associated with minor (i) event-related, (ii) activity-related, and (iii) composite stress (as previously operationalized in experience sampling studies [21,31,32]); and (3) positive affective recovery from stress—operationalized as the average decrease of positive affect from baseline across the period between the occurrence of minor stress and return to baseline. Echoing previous findings that individuals with early stages of mental disorder experience the most pronounced reactions related to stress, marked by reactivity [13,18-20] and negative affective recovery [20], compared with patients with an enduring mental disorder, we aimed to investigate group differences between at-risk individuals and patients. Specifically, we sought to test the following hypotheses (see Multimedia Appendix 1):

H1: Within each group (patients with a mental disorder, at-risk individuals, controls), exposure to (i) event-related, (ii) activity-related, or (iii) composite stress is associated with (a) an initial decrease in positive affect (ie, stress reactivity) and (b) subsequent to initial stress reactivity, lower levels of positive affect before recovering to baseline level (ie, affective recovery).

H2: Baseline levels of positive affect, that is, prior to reporting (i) event-related, (ii) activity-related, or (iii) composite stress,

are lower in (a) patients with a mental disorder than in controls, (b) at-risk individuals than in controls, and (c) at-risk individuals than in patients with a mental disorder.

H3: Positive affective reactivity from minor stress is greater in (a) patients with a mental disorder than in controls, (b) at-risk individuals than in controls, and (c) at-risk individuals than in patients with a mental disorder.

H4: Positive affective recovery from minor stress, that is, the average decrease of positive affect from baseline before returning to baseline levels of positive affect following (i) event-related, (ii) activity-related, or (iii) composite stress, is greater in (a) patients with a mental disorder than in controls, (b) at-risk individuals than in controls, and (c) at-risk individuals than in patients with a mental disorder.

Methods

Samples

The pooled sample comprised participants from 8 previously conducted studies that used a similar protocol and are part of the ESM merge file. These studies included individuals with a mental disorder, that is, psychotic disorder [17,33-38] or depressive disorder with residual symptoms [39]; at-risk individuals, that is, with familial [17,34,36,40] or psychometric risk for psychosis [19,38]; and controls without a personal or family history of mental disorder [17,19,34,36,38,40]. The samples and procedures to obtain diagnoses and risk status of the participants have been described elsewhere (see Multimedia Appendix 2).

Ethical Approval

All 8 studies received approval by their respective medical ethics committees in the Netherlands and Belgium as stated in the original references and all procedures were performed in accordance with the ethical standards of the responsible medical ethics committee. This study was registered on OSF (Open Science Framework) before data access [41].

Data Collection

Experience Sampling Method

Data were collected using the ESM, a structured diary technique [16,42]. Participants received a digital wristwatch that sent 10 signals per day at pseudo-random time points in blocks of 90 minutes between 7.30 AM and 10.30 PM for 6 consecutive days. The signal prompted participants to complete questionnaires on their current mood, symptoms, and context that they had previously received in a booklet. To ensure compliance with the experience sampling procedure, only prompts answered within 15 minutes after the programmed signal and participants who answered a minimum of 20 prompts were included in the analysis.

ESM Measures

For the current analysis, experience sampling constructs available in all included studies were selected to measure positive affect, momentary event-related stress, and momentary activity-related stress. Positive affect was measured with 3 items beginning with "I feel" followed by the adjectives "cheerful," "relaxed," and "satisfied" (1=not at all; 7=very much). Based on previous experience sampling studies [15,17,18], momentary stress was operationalized by 2 types of minor stressors. Event-related stress was measured by asking about the most important event for the participant that happened since the last prompt. Participants then indicated how pleasant this event was on a bipolar scale (–3=very unpleasant; 3=very pleasant, which was recoded to 1=very pleasant to 7=very unpleasant, to match the other scales). To measure activity-related stress, participants were asked what they were doing at the moment followed by 4 questions on their current activity: "This costs energy," "I'm skilled at this" (reverse coded), "This is a challenge," and "I prefer doing something else" (1=not at all; 7=very much).

Mean scores of the 3 positive affect items were centered around the person and day means and z standardized. In addition to momentary event– and activity-related stress, after justifying its use by principal component analysis (see Multimedia Appendix 3), a composite stress measure indicating the presence of one or both types of stress combined (0=no stress; 1=one or both types of stress) was created (see [21,31,32]). Individuals who never reported stress and days on which no stress was reported were excluded from the analysis.

Statistical Analysis

Stata version 16.0 (StataCorp LLC) was used for statistical analysis [43]. Experience sampling data have a 3-level structure with individual assessments (level 1) nested within days (level 2), which are, in turn, nested within individuals (level 3). Group differences on level 3 variables (ie, age and gender) were examined using 1-way ANOVAs and chi-square tests as appropriate, whereas group differences on levels 1 and 2 were examined using Stata's "mixed" command for multilevel models.

To test the hypotheses, the procedure described by Vaessen et al [20] was followed. Trajectories of positive affect in response to the first stressor of a day were examined to rule out the potential cumulative impact of consecutive stressors throughout a day on positive affect. A new predictor variable "time_since" was created for each stress measure to mark the time points when positive affect was measured in relation to the first stressor of the day. The time point when the stressor occurred (ie, stress reactivity) was set to t_0, the time point prior to this (ie, t_{-1}) served as the baseline, and all time points following the stressor were set to t_{1-n}. First, to test H1, in a separate model for each group using time_since to predict positive affect, we compared all time points t_{0-n} with baseline. Second, to test H2, group was added as a predictor in the model and group comparisons of positive affect were calculated at baseline and t_0. Third, to test H3, an interaction between time_since and group was specified in the model to compare affective reactivity at t_0 between groups. Last, affective recovery was compared between groups (H4) using the average decrease of positive affect from baseline across the recovery period. Specifically, a recovery period of 2 prompts was specified as the average deviation of positive affect at these time points from baseline positive affect.

For each momentary stressor (event-related, activity-related, and composite stress), separate models were fitted. For each

model, observations were excluded (i) for participants who never reported the specific type of stress, (ii) for days on which the specific type of stress was not reported, and (iii) for days on which the specific type of stress was reported on the first prompt of the day so that no baseline measure was available.

All models were adjusted for age (centered using the grand mean) and gender (for unadjusted models, see Multimedia Appendix 4). As a sensitivity analysis, the analysis was repeated controlling for subsequent stressors. To this end, dichotomous control variables were created for event- and activity-related, or composite stress indicating the presence (=1) or absence (=0) of the respective stressor at all time points $t_{n>0}$. We used Simes correction [44] to account for multiple tests of significance regarding our 3 stress measures, as all models testing our specific hypotheses were repeated for each stress measure. Therefore, according to the Simes procedure, the most significant *P* value within each model was compared with α=.05/3=.02 and the second most significant *P* value was compared with α=.05/2=.03. Results that remain significant after Simes correction are marked with footnotes in tables. A significance level of *P*<.05 was set for all remaining *P* values.

Results

Sample Characteristics

The sample comprised 921 participants. This includes 422 individuals with a mental disorder (ie, 293 with psychotic disorder and 129 with remitted depressive disorder with residual symptomatology), 246 at-risk individuals (ie, 178 with familial and 68 with psychometric risk), and 253 controls. Participants completed a total of 42,778 prompts. Average compliance was 75% (45/60 prompts) for patients, 78% (47/60 prompts) for at-risk individuals, and 82% (49/60 prompts) for controls ($F_{2,918}$=13.02, *P*<.001). Across groups, 2304 prompts were not completed within 15 minutes after the signal or all positive affect and stress items were missing (χ^2_2=21.2, *P*<.001). In addition, 34 participants completed less than 20 prompts over 6 days (χ^2_2=2.8, *P*=.24) and 75 participants never reported any type of stress (χ^2_2=0.01, *P*=.95) and were therefore excluded from the analysis.

Hence, the analytic sample consisted of 811 participants (patients/at-risk/controls: n=367/217/227) with a total of 39,903 valid prompts (patients/at-risk/controls: n=16,122/9997/10,784). Sample characteristics of the analytic sample are depicted in Table 1.

Table 1. Basic sample characteristics.

Characteristic	Patients (n=367)	At-risk (n=217)	Controls (n=227)	Test statistic	*P* value	Significant contrasts
Gender, n				χ^2_2=7.7	.02	
Male	187	90	93			
Female	180	127	134			
Age, mean (SD)	38.07 (11.42)	36.41 (13.12)	35.50 (12.56)	$F_{2,806}$=3.4	.04	Patients versus controls
Observations per person, mean (SD)	43.93 (10.07)	46.07 (9.21)	47.51 (9.10)	$F_{2,808}$=10.3	<.001	Patients versus controls
Stressful days per person, mean (SD)	5.92 (0.58)	5.96 (0.41)	5.99 (0.48)	$F_{2,808}$=1.4	.25	
Time of first stressor[a], mean	2:59 PM	3:07 PM	2:55 PM	$F_{2,769}$=0.3	.72	
Unpleasantness of first stressor[a], mean (SD)	2.00 (0.62)	1.88 (0.63)	1.91 (0.63)	$F_{2,770}$=3.1	.04	Patients versus at-risk
Positive affect, mean (SD)	4.27 (0.93)	4.89 (0.94)	5.16 (0.71)	$F_{2,808}$=79.4	<.001	At-risk versus controls; patients versus controls; patients versus at-risk

[a]Excluding stressors that were reported at the first prompt of the day.

Recovery Period Within Groups (H1)

Patients

Patients showed a decrease in positive affect in response to all types of stress (event-related stress: *b*=–0.35, 95% CI –0.43 to –0.28, *P*<.001; activity-related stress: *b*=–0.49, 95% CI –0.60 to –0.38, *P*<.001; composite stress: *b*=–0.38, 95% CI –0.45 to –0.31, *P*<.001). Following event-related stress, recovery occurred at t_1, that is, patients had immediately returned to baseline levels of positive affect (*b*=–0.06, 95% CI –0.13 to 0.02, *P*=.16). Following activity-related (*b*=–0.14, 95% CI –0.26 to –0.02, *P*=.02) and composite stress (*b*=–0.11, 95% CI –0.19 to –0.04, *P*<.01), patients still showed a significant decrease at t_1. At t_2, patients also had returned to baseline levels of positive affect following activity-related stress (*b*=0.01, 95% CI –0.12 to 0.13, *P*=.90) and composite stress (*b*=–0.01, 95% CI –0.09 to 0.06, *P*=.71).

At-Risk Individuals

At-risk individuals showed a decrease in positive affect in response to all types of stress (event-related stress: *b*=–0.34, 95% CI –0.43 to –0.26, *P*<.001; activity-related stress: *b*=–0.54, 95% CI –0.68 to –0.40, *P*<.001; composite stress: *b*=–0.38, 95%

CI –0.46 to –0.30, *P*<.001). Following event-related stress, recovery occurred at t_1, that is, at-risk individuals had immediately returned to baseline levels of positive affect (*b*=–0.75, 95% CI –0.16 to 0.02, *P*=.10). Following activity-related (*b*=–0.17, 95% CI –0.33 to –0.02, *P*=.03) and composite stress (*b*=–0.11, 95% CI –0.20 to –0.03, *P*=.01), at-risk individuals still showed a significant decrease at t_1. At t_2, at-risk individuals also had returned to baseline levels of positive affect following activity-related stress (*b*=–0.09, 95% CI –0.25 to 0.07, *P*=.27) and composite stress (*b*=–0.05, 95% CI –0.14 to 0.03, *P*=.23).

Controls

As with the other groups, controls showed a decrease in positive affect in response to all types of stress (event-related stress: *b*=–0.27, 95% CI –0.35 to –0.19, *P*<.001; activity-related stress: *b*=–0.60, 95% CI –0.74 to –0.46, *P*<.001; composite stress: *b*=–0.32, 95% CI –0.40 to –0.25, *P*<.001). Similar to patients and at-risk individuals, controls returned to baseline levels of positive affect immediately at t_1 following event-related stress (*b*=–0.04, 95% CI –0.13 to 0.04, *P*=.32). Controls had also recovered immediately at t_1 following activity-related (*b*=–0.15, 95% CI –0.30 to 0.001, *P*=.05) and composite stress (*b*=–0.07, 95% CI –0.15 to 0.01, *P*=.10; Table 2).

Table 2. Within-group analysis of all stress measures comparing positive affect at baseline (t_{-1}) with time points t_0 (stress reactivity), t_1, and t_2 (all groups recovered) adjusted for age and gender[a].

Stress type	Patients		At-risk		Controls	
	b (CI)	*P* value	*b* (CI)	*P* value	*b* (CI)	*P* value
Event-related stress[b]						
t_0	–0.35 (–0.43 to –0.28)	<.001[c]	–0.34 (–0.43 to –0.26)	<.001[c]	–0.27 (–0.35 to –0.19)	<.001[c]
t_1	–0.06 (–0.13 to 0.02)	.16	–0.08 (–0.16 to 0.02)	.10	–0.04 (–0.13 to 0.04)	.32
Age	–0.002 (–0.01 to 0.01)	.52	0.01 (0.002 to 0.02)	.01[c]	0.01 (0.004 to 0.02)	.001[c]
Gender	–0.13 (–0.28 to 0.03)	.11	0.06 (–0.14 to 0.27)	.56	0.001 (–0.16 to 0.16)	.99
Activity-related stress[d]						
t_0	–0.49 (–0.60 to –0.38)	<.001[c]	–0.54 (–0.68 to –0.40)	<.001[c]	–0.60 (–0.74 to –0.46)	<.001[c]
t_1	–0.14 (–0.26 to –0.02)	.02[c]	–0.17 (–0.33 to –0.02)	.03	–0.15 (–0.30 to 0.001)	.05
t_2	0.008 (–0.12 to 0.13)	.90	–0.09 (–0.25 to 0.07)	.27	–0.09 (–0.24 to 0.06)	.25
Age	–0.0004 (–0.01 to 0.01)	.92	0.01 (0.004 to 0.02)	.005[c]	0.009 (0.001 to 0.02)	.03
Gender	–0.22 (–0.42 to –0.02)	.03	0.05 (–0.21 to 0.30)	.72	0.07 (–0.16 to 0.29)	.55
Composite stress measure						
t_0	–0.38 (–0.45 to –0.31)	<.001[c]	–0.38 (–0.46 to –0.30)	<.001[c]	–0.32 (–0.40 to –0.25)	<.001[c]
t_1	–0.11 (–0.19 to –0.04)	.004[c]	–0.11 (–0.20 to –0.03)	.01	–0.07 (–0.15 to 0.01)	.10
t_2	–0.02 (–0.09 to 0.06)	.66	–0.05 (–0.14 to 0.03)	.23	–0.09 (–0.18 to –0.01)	.03
Age	–0.001 (–0.01 to 0.01)	.71	0.01 (0.004 to 0.02)	.003[c]	0.01 (0.003 to 0.02)	.002[c]
Gender	–0.12 (–0.27 to 0.03)	.12	0.07 (–0.12 to 0.27)	.47	–0.01 (–0.17 to 0.14)	.88

[a]Time point t_{-1} (ie, baseline) serves as reference category; effect of female gender is depicted.

[b]Missing cases: $n_{individuals}$=30; $n_{prompts}$=1182.

[c]Significant after Simes correction.

[d]Missing cases: $n_{individuals}$=348; $n_{prompts}$=7680.

Recovery Period Within Groups Controlled for Subsequent Stressors

When controlling for subsequent stressors in the within-group analysis, that is, the presence or absence of a stressor at the time points after the initial stressor, none of the groups showed a delayed recovery irrespective of the type of stressor. For the composite stress measure, all groups showed a decrease in positive affect at t_0 compared with t_{-1} (controls: *b*=–0.32, 95% CI –0.40 to –0.25, *P*<.001; at-risk: *b*=–0.38, 95% CI –0.46 to –0.31, *P*<.001; patients: *b*=–0.38, 95% CI –0.45 to –0.31, *P*<.001). At t_1, all groups had returned to baseline levels of positive affect (controls: *b*=0.02, 95% CI –0.06 to 0.10, *P*=.58; at-risk: *b*=–0.03, 95% CI –0.11 to 0.06, *P*=.53; patients: *b*=0.03, 95% CI –0.04 to 0.11, *P*=.42). Subsequent stress as a control variable was significantly associated with positive affect in all models (controls: *b*=–0.47, 95% CI –0.54 to –0.39, *P*<.001; at-risk: *b*=–0.40, 95% CI –0.48 to –0.32, *P*<.001; patients:

b=–0.53; 95% CI –0.60 to –0.47, *P*<.001). Similar patterns were found for event-related and activity-related stress (Table 3).

Table 3. Within-group analysis of all stress measures comparing positive affect at baseline (t_{-1}) with time points t_0 (stress reactivity), t_1, and t_2 (all groups recovered) adjusted for age and gender, and subsequent stress[a].

Stress type	Patients		At-risk		Controls	
	b (CI)	*P* value	*b* (CI)	*P* value	*b* (CI)	*P* value
Event-related stress[b]						
t_0	–0.36 (–0.43 to –0.29)	<.001[c]	–0.35 (–0.44 to –0.27)	<.001[c]	–0.29 (–0.37 to –0.21)	<.001[c]
t_1	0.07 (–0.01 to 0.15)	.08	–0.02 (–0.11 to 0.08)	.74	0.01 (–0.08 to 0.10)	.82
Age	–0.003 (–0.01 to 0.004)	.45	0.01 (0.002 to 0.02)	.01	0.01 (0.004 to 0.02)	.001
Gender	–0.11 (–0.26 to 0.04)	.16	0.06 (–0.14 to 0.27)	.55	0.01 (–0.14 to 0.17)	0.87
Subsequent stress	–0.54 (–0.61 to –0.47)	<.001[c]	–0.37 (–0.46 to –0.28)	<.001[c]	–0.39 (–0.48 to –0.30)	<.001[c]
Activity-related stress[d]						
t_0	–0.49 (–0.60 to –0.38)	<.001[c]	–0.54 (–0.68 to –0.40)	<.001[c]	–0.61 (–0.75 to –0.47)	<.001[c]
t_1	–0.07 (–0.19 to 0.05)	.23	–0.07 (–0.23 to 0.10)	.42	–0.08 (–0.23 to 0.07)	.28
t_2	0.07 (–0.06 to 0.19)	.30	–0.03 (–0.19 to 0.14)	.74	–0.07 (–0.23 to 0.08)	.35
Age	–0.001 (–0.01 to 0.01)	.90	0.01 (0.003 to 0.02)	.008	0.009 (0.0002 to 0.02)	.04
Gender	–0.21 (–0.41 to –0.01)	.04	0.06 (–0.19 to 0.31)	.65	0.07 (–0.15 to 0.29)	.54
Subsequent stress	–0.58 (–0.73 to –0.44)	<.001[c]	–0.66 (–0.87 to –0.45)	<.001[c]	–0.60 (–0.80 to –0.40)	<.001[c]
Composite stress measure						
t_0	–0.38 (–0.45 to –0.31)	<.001[c]	–0.38 (–0.46 to –0.31)	<.001[c]	–0.32 (–0.40 to –0.25)	<.001[c]
t_1	0.03 (–0.04 to 0.11)	.42	–0.03 (–0.11 to 0.06)	.53	0.02 (–0.06 to 0.10)	.58
t_2	0.08 (0.01 to 0.16)	.04	0.02 (–0.07 to 0.10)	.72	–0.02 (–0.10 to 0.06)	.65
Age	–0.001 (–0.01 to 0.01)	.69	0.01 (0.003 to 0.02)	.004	0.01 (0.003 to 0.02)	.003
Gender	–0.11 (–0.26 to 0.04)	.15	0.073 (–0.119 to 0.265)	.45	–0.003 (–0.155 to 0.148)	.966
Subsequent stress	–0.53 (–0.60 to –0.47)	<.001[c]	–0.40 (–0.48 to –0.32)	<.001[c]	–0.47 (–0.54 to –0.39)	<.001[c]

[a]Time point t_{-1} (ie, baseline) serves as reference category; effect of female gender is depicted.

[b]Missing cases: $n_{individuals}$ = 30; $n_{prompts}$ = 1182.

[c]Significant after Simes correction.

[d]Missing cases: $n_{individuals}$ = 348; $n_{prompts}$ = 7680.

Differences in Baseline (H2), Reactivity (H3), and Recovery (H4) Across Groups

Figure 1 shows the trajectories of positive affect in response to composite stress in all groups. A main effect of group was observed for all stress measures (event-related stress: χ^2_2=1575.64, *P*<.001; activity-related stress: χ^2_2=48.69, *P*<.001; composite stress: χ^2_2=200.9, *P*<.001). There were differences in baseline levels of positive affect across all groups, consistent with H2 (Table 4). However, patients and at-risk individuals did not differ as hypothesized. Patients had significantly lower baseline levels of positive affect than at-risk individuals (*P* values for all stress types <.001). There was no evidence for a 2-way interaction (time_since × group) at t_0 for any stress measure. This indicated that the associations of event-related stress, activity-related stress, or composite stress with positive affect, that is, the initial positive affective reactivity, did not differ across individuals at different stages of mental disorder, leaving H3 unsupported. As all groups had returned to baseline levels of positive affect by t_2 following activity-related and composite stress, marking the end point of the continuous recovery period, t_1–t_2 were included in the between-group analysis. When examining differences in the average deviation of positive affect from baseline levels during the recovery period t_1–t_2 in response to activity-related stress and composite stress, we did not find evidence for between-group differences (Table 4). This indicated that positive affective recovery, operationalized as an average deviation from baseline, was similar across the groups at different stages of mental disorder, leaving H4 unsupported.

Figure 1. Trajectories of positive affect following composite stress. (Adjusted predictive margins of the multilevel regression analysis for the composite stress measure are displayed. Error bars represent 95% CIs.)

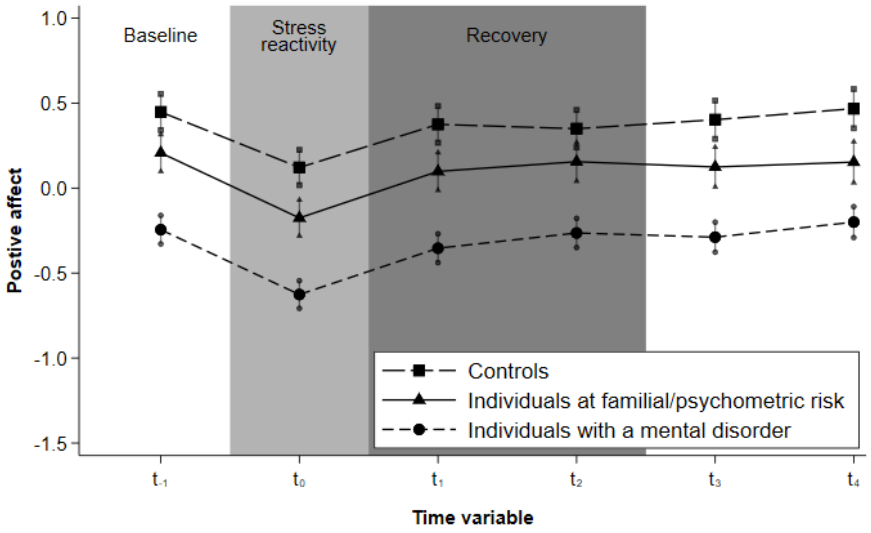

Table 4. Differences in baseline positive affect (t_{-1}), stress reactivity (t_0), and affective recovery (average deviation of positive affect from baseline levels during $t_1 - t_2$) between groups[a].

Stress type	At-risk versus controls		Patients versus controls		Patients versus at-risk	
	b (95% CI)	*P* value	*b* (95% CI)	*P* value	*b* (95% CI)	*P* value
Activity stress						
t_{-1}	–0.34 (–0.57 to –0.11)	.003[b]	–0.74 (–0.95 to –0.54)	<.001[b]	–0.40 (–0.60 to –0.21)	<.001[b]
t_0	0.06 (–0.15 to 0.27)	.57	0.11 (–0.07 to 0.29)	.23	0.05 (–0.13 to 0.23)	.58
t_1–t_2	–0.01 (–0.21 to 0.18)	.89	0.05 (–0.12 to 0.22)	.57	0.06 (–0.11 to 0.23)	.46
Event stress[c]						
t_0	–0.07 (–0.19 to 0.05)	.27	–0.09 (–0.19 to 0.03)	.13	–0.02 (–0.13 to 0.09)	.76
Composite stress						
t_{-1}	–0.28 (–0.43 to –0.13)	<.001[b]	–0.44 (–0.57 to –0.31)	<.001[b]	–0.44 (–0.57 to –0.31)	<.001[b]
t_0	–0.06 (–0.17 to 0.06)	.35	–0.06 (–0.16 to 0.05)	.30	0.001 (–0.10 to 0.11)	.99
t_1–t_2	0.01 (–0.10 to 0.12)	.89	0.02 (–0.07 to 0.12)	.62	0.02 (–0.08 to 0.11)	.74

[a]Adjusted for age and gender.

[b]Significant after Simes correction.

[c]Model for t_{-1} did not converge.

Discussion

Principal Findings

This study aimed to investigate trajectories of positive affect in response to daily life stress across different transdiagnostic clinical stages in a pooled sample of patients with a mental disorder, individuals at psychometric or familial risk, and controls. All groups showed a similar trajectory of positive affect in response to momentary stress, as indicated by a decrease in positive affect to event-related, activity-related, or composite stress, and a continuously lower level of positive affect before recovering to baseline level in response to activity-related or composite stress (H1). We observed a continuous recovery period of 180 minutes on average in patients and at-risk individuals, whereas controls required 90 minutes on average to recover. Comparisons across groups revealed that patients with a mental disorder and at-risk individuals had lower baseline levels of positive affect in daily life compared with controls (H2). Contrary to our prediction, patients had lower levels of positive affect compared with at-risk individuals. Differences in positive affective reactivity to daily stress between groups (H3) and in positive affective recovery fell short of statistical significance (H4).

Methodological Considerations

Several methodological considerations should be taken into account when interpreting the reported findings. First, because this study used existing data, participants with different clinical characteristics were pooled to form transdiagnostic groups as

an approximation to representing subclinical and clinical stages of mental disorder based on the literature of clinical staging. To further support the staging approach and ensure that participants with different clinical characteristics form a group regarding severity of symptoms or functional impairment as suggested by clinical staging, latent class analysis may be used in future analysis to identify groups with similar behavioral patterns. Furthermore, participants may be recruited according to recently developed criteria for clinical staging as there is first evidence for their validity as a way of identifying individuals in early stages with predictive power for transition between stages [3].

Second, the dichotomous operationalization of stress as the presence or absence of a stressor does not account for the degree of unpleasantness of a reported activity or event, which reduces variance. An activity or event rated as –3 may impact positive affect longer than an activity or event rated as –1. Similarly, Vaessen et al [45] showed that emotional reactivity to mild, but not intermediate or strong stressors was related to symptom levels in adolescents 1 year later, suggesting that the degree of unpleasantness of a stressor may need to be accounted for in future studies on affective recovery.

Third, stress reactivity at t_0 was modeled in a cross-sectional manner, that is, ratings of stress and positive affect measured at the same time point were used to define stress reactivity. Therefore, temporal order between the first stressor of a day and an associated decrease in positive affect remains unclear as a stressor may lead to a decrease in positive affect, or vice versa. Yet, the cross-sectional modeling does not restrict interpretations regarding the recovery period, which was of main interest in this study, operationalized using time points chronologically before and after the occurrence of stress.

Relatedly, the exploratory finding that positive affective recovery within groups may be accounted for by cumulative stress at the following time points should be interpreted with caution. A recent review showed that experiencing positive affect can impact the neural signaling of stress, which may lead to less self-reported stress [46]. As the temporal order between cumulative stress and positive affect measured at the same time point remains unclear, it may, in turn, be possible that being in the recovery period, that is, in a state of decreased positive affect, may lead participants to report more stress.

Last, the composite stress measure combining event- and activity-related stress may hold restrictions. Both stress types may be related to affective recovery in different ways. Specifically, event-related stress is a retrospective judgment of the most important event that happened since the last prompt. As the time points were approximately 90 minutes apart, the unpleasant event might have happened up to 90 minutes before the rating, meaning that an immediate drop in positive affect after the event and the beginning of the recovery period might not have been recorded by the random sampling procedure. Activity-related stress, by contrast, measures the unpleasantness of the current activity. The sampling procedure does not reveal when an unpleasant activity started or for how long it was continued after the measurement, which may also influence positive affect ratings at baseline or during the recovery period.

We found no recovery period after event-related stress and effect sizes were lower at t_0 for event-related stress than at the same time point for activity-related stress (Table 2), indicating that the recovery period for event-related stress may have already begun before reporting the event. Taken together, the sampling procedure in this study may have been limited in detecting differences in positive affective recovery between groups. For future research, a design with more frequent measurements or a hybrid event- and time-contingent sampling procedure may provide more fine-grained modeling of affective recovery.

Comparison to Prior Research

In line with previous research [15,47], our study showed that levels of positive affect differed between individuals with a mental disorder, individuals at-risk for developing a mental disorder, and controls across the continuum of mental health, thus broadening findings to a transdiagnostic staging approach for the first time. While all groups reported stress reactivity and a period of affective recovery in response to activity-related and overall stress that was descriptively longer within the patient group and at-risk individuals, these differences fell short of statistical significance in between-group analysis comparing average deviations of positive affect from baseline levels. Yet, levels of positive affect in patients and at-risk individuals were generally lower across the entire recovery period (Figure 1). This may suggest that reactivity of similar magnitude and a recovery period of similar length may be associated more strongly with risk and disorder when operating on lower overall levels of positive affect.

Furthermore, the magnitude of differences in positive affective reactivity and recovery between groups might have been too small to be detected with the number of observations per day in our models. In addition, criteria other than clinical status might be relevant to index risk and identify group differences in trajectories of positive affect in response to minor stressors, such as childhood adversities. In line with the stress sensitization hypothesis [12], stress reactivity as a behavioral marker for stress sensitization has been shown to be amplified in individuals exposed to severe adversity across the life course [22,48-51]. For instance, stress reactivity in early and later stages of psychopathology has been reported to be greater in individuals exposed to high levels of childhood adversity than in controls exposed to high levels of adversity, suggesting they were more resilient [22]. Future research should investigate whether this holds true for differences in positive affective recovery as a transdiagnostic marker for momentary resilience, that is, the ability to recover from minor stressors in the moment. Differences in affective recovery across stages may only become evident when viewed in the context of exposure to adversities across the life course.

To our knowledge, this is the first study to transdiagnostically investigate the trajectories of positive affect after minor stressors in daily life. It has been shown that positive and negative affect can be conceptualized as 2 distinct factors [52] that are related to positive and negative events in daily life in different ways. For example, negative events were found to be less strongly related to positive than to negative affect [53]. Similarly, Wichers et al [54] found that physical activity, which may be

regarded as a positive activity, was related to momentary positive affect, but unrelated to momentary negative affect. Adding to previous findings [20], we found a shorter period of positive affective recovery after a negative event than was found for negative affective recovery after a negative event. Furthermore, group differences in negative affective recovery between at-risk individuals and individuals with a mental disorder were not reflected in our findings regarding positive affective recovery. Taken together, this may suggest that the trajectories of positive and negative affect in response to minor daily stressors constitute separate psychological mechanisms. This underlines the differential role of positive affect for psychological well-being [24,27] and highlights the need to investigate, in more detail, how positive and negative affective recovery compare in stages of mental disorder.

Implications

In this study, we found first evidence for different trajectories of positive affect following minor daily stressors in a transdiagnostic sample covering the continuum of mental health. Whether positive affective recovery on the scale of minor stressors in daily life may be a putative indicator for momentary resilience should be investigated further in the context of childhood adversity, specifically focusing on healthy, that is, resilient, individuals exposed to adversities. When disentangling this putative protective mechanism further, trajectories of affective recovery may potentially serve as a target for ecological momentary interventions, a mobile health approach using mobile devices to deliver interventions in daily life [55,56]. Targeting affective recovery, intervention components may potentially be presented in moments when participants experience stress helping them to recover, and ultimately foster resilience in early and later stages of psychopathology. Targeting this putative momentary mechanism in ecological momentary interventions allowing the use of experimental designs in daily life [57] may allow us to understand more fully the role of affective recovery in pathways to severe mental disorder. This will provide evidence for the effectiveness and feasibility of scalable interventions for transdiagnostic populations.

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Data Availability

Data pertain to the ESM merge file. The ESM merge file is a data set combining multiple ESM studies that have been performed at Maastricht University. Data are available upon reasonable request from researchers. Researchers can send their request to the Department of Psychiatry & Neuropsychology of Maastricht University, School for Mental Health and Neuroscience, by sending an email to info@esm-maastricht.nl.

Authors' Contributions

LA performed data analysis and drafted the manuscript. AS and UR supervised the study and AS, CS, IM-G, and UR were involved in critical revision of the manuscript. TV provided advice on statistical analysis and LA, AS, and UR interpreted the findings. LA, AS, IM-G, TV, and UR developed the conception and all authors contributed to the design of this study. CS, PD, and IM-G were involved in data acquisition for the data used in the analysis. All authors have read and approved the final version of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Graphic illustration of the expected trajectories of positive affect in the context of a minor daily stressor in subclinical and clinical stages of mental disorder.
[DOCX File , 60 KB - mental_v9i11e37394_app1.docx]

Multimedia Appendix 2
Overview of pooled studies.
[DOCX File , 17 KB - mental_v9i11e37394_app2.docx]

Multimedia Appendix 3
Principle component analysis of the composite stress measure.
[DOCX File , 15 KB - mental_v9i11e37394_app3.docx]

Multimedia Appendix 4
Unadjusted within-group analysis comparing positive affect at baseline (t_{-1}) to time points t_0 (stress reactivity) to t_n (all groups recovered).
[DOCX File , 17 KB - mental_v9i11e37394_app4.docx]

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Abbreviations

ESM: experience sampling methodology

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Original Paper

Development of the First Episode Digital Monitoring mHealth Intervention for People With Early Psychosis: Qualitative Interview Study With Clinicians

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Abstract

Background: Mobile health (mHealth) technologies have been used extensively in psychosis research. In contrast, their integration into *real-world* clinical care has been limited despite the broad availability of smartphone-based apps targeting mental health care. Most apps developed for treatment of individuals with psychosis have focused primarily on encouraging self-management skills of patients via practicing cognitive behavioral techniques learned during face-to-face clinical sessions (eg, challenging dysfunctional thoughts and relaxation exercises), reminders to engage in health-promoting activities (eg, exercising, sleeping, and socializing), or symptom monitoring. In contrast, few apps have sought to enhance the clinical encounter itself to improve shared decision-making (SDM) and therapeutic relationships with clinicians, which have been linked to positive clinical outcomes.

Objective: This qualitative study sought clinicians' input to develop First Episode Digital Monitoring (FREEDoM), an app-based mHealth intervention. FREEDoM was designed to improve the quality, quantity, and timeliness of clinical and functional data available to clinicians treating patients experiencing first-episode psychosis (FEP) to enhance their therapeutic relationship and increase SDM.

Methods: Following the app's initial development, semistructured qualitative interviews were conducted with 11 FEP treatment providers at 3 coordinated specialty care clinics to elicit input on the app's design, the data report for clinicians, and planned usage procedures. We then generated a summary template and conducted matrix analysis to systematically categorize suggested adaptations to the evidence-based intervention using dimensions of the Framework for Reporting Adaptations and Modifications ‐ Enhanced (FRAME) and documented the rationale for adopting or rejecting suggestions.

Results: The clinicians provided 31 suggestions (18 adopted and 13 rejected). Suggestions to add or refine the content were most common (eg, adding questions in the app). Adaptations to context were most often related to plans for implementing the intervention, how the reported data were displayed to clinicians, and with whom the reports were shared. Reasons for suggestions primarily included factors related to health narratives and priorities of the patients (eg, focus on the functional impact of symptoms vs their severity), providers' clinical judgment (eg, need for clinically relevant information), and organizations' mission and culture. Reasons for rejecting suggestions included requests for data and procedures beyond the intervention's scope, concerns regarding dilution of the intervention's core components, and concerns about increasing patient burden while using the app.

Conclusions: FREEDoM focuses on a novel target for the deployment of mHealth technologies in the treatment of FEP patients—the enhancement of SDM and improvement of therapeutic relationships. This study illustrates the use of the FRAME, along with methods and tools for rapid qualitative analysis, to systematically track adaptations to the app as part of its development process. Such adaptations may contribute to enhanced acceptance of the intervention by clinicians and a higher likelihood of integration into clinical care.

Trial Registration: ClinicalTrials.gov NCT04248517; https://tinyurl.com/tjuyxvv6

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KEYWORDS

first-episode psychosis; early psychosis; coordinated specialty care; mental health treatment; shared decision-making; mobile health; smartphone apps; qualitative; digital psychiatry; mobile phone

Introduction

Early Intervention for Psychosis and Measurement-Based Care

Early treatment experiences of individuals diagnosed with schizophrenia can have enduring effects on their attitudes toward treatment, potentially altering the course of illness and affecting long-term outcomes [1,2]. Consequently, first-episode psychosis (FEP) is a critical period for optimizing treatment to enhance treatment satisfaction and adherence [3]. Specifically, psychotropic medications are critical core components of early intervention strategies. However, evidence suggests that a significant gap exists between the optimal use of medications and how they are used in real-world practice [4], with many patients receiving higher than recommended dosages of antipsychotic medications, as well as additional psychotropic medications. These practices often result in troubling symptoms and side effects, lower satisfaction with treatment, poorer therapeutic relationship and treatment engagement, and increased rates of discontinuation of treatment [1,4].

One widely promoted approach to improve treatment outcomes is measurement-based care (MBC), which is defined as the systematic evaluation of patient conditions before or during an encounter to inform treatment [5,6]. Typically, MBC relies on the patients' recollection of their clinical status over several days or weeks. However, such retrospective assessments are problematic because they are vulnerable to the influence of memory difficulties, cognitive biases, and reframing [7-9]. These issues are particularly salient among individuals with schizophrenia, given the substantial episodic memory deficits documented in this population [10,11]. In addition, medication management sessions by psychiatrists and other prescribing clinicians typically last <30 minutes, making it difficult for providers to obtain a comprehensive view of the clinical status of patients and develop rapport. The latter is particularly pertinent for patients with FEP, about whom psychiatric care providers may have shorter treatment histories, resulting in less familiarity. Overall, these limitations may contribute to lower treatment satisfaction and adherence, poorer therapeutic relationship, and poorer clinical outcomes.

A promising strategy to overcome many of these challenges is the use of mobile health (mHealth) technologies. Extensive evidence from psychosis research studies using smartphones indicates high feasibility and validity of real-time collection of clinical information on daily experiences among individuals with psychosis, including symptoms, side effects, mood and affective processing, social activities and context, sleep, and functioning [9,12-15]. Using apps and methodologies, such as experience sampling method (ESM) that present patients with brief assessments that are more frequent and richer in detail and occur during the course of "real-world" functioning, mHealth technologies can provide a more granular and complete picture of clinical status and functioning of patients upon which more effective clinical decisions and pharmacological management can be made [9,13,16,17]. Specifically, mHealth technologies can capture changes in clinical variables across time and social contexts, potentially allowing providers to better tailor interventions. Furthermore, the "real-world" characterization of experiences of patients via mHealth technologies may also enhance shared decision-making (SDM) and therapeutic relationship by providing both clinicians and patients with more accurate clinical data that are more directly related to experiences of patients, potentially allowing for more informed joint treatment decisions.

mHealth Applications in Psychosis Treatment

To date, most apps developed for and used in the treatment of individuals with psychosis, including FOCUS [18-20], CORE [21], Actissist [22], and Acceptance and Commitment Therapy in Daily Life [23], have focused largely on supplementing face-to-face clinical encounters [16,17,24-28]. Most apps have been designed primarily to facilitate patients' self-management of symptoms and recovery by offering psychoeducation, guidelines for practicing of cognitive and behavioral coping strategies (eg, reassessment of dysfunctional beliefs and relaxation exercises), or other skills taught during clinical sessions. Other apps have focused on monitoring symptoms and signs of clinical deterioration or enhancing social functioning [29-32]. In contrast, few apps have sought to enhance the clinical encounter itself. Specifically, to date, no app has aimed to enhance SDM and therapeutic relationships within FEP treatment. SDM has been shown to be a key element contributing to positive clinical outcomes [33,34]. Previous reports have demonstrated that SDM has a positive impact on patient satisfaction, adherence to treatment, quality of life, and empowerment, including among patients with serious mental illness [35-38]. Consistent with this view, Zielesak et al [39] pointed out that there remains a significant gap in understanding clinician needs for information in mental health care decision-making, as well as ways to better integrate apps into

routine clinical care and provider workflow. Furthermore, providers' lack of engagement with, or buy-in for, patient-reported health data have been noted as a critical barrier to its use in health care generally, making it a priority to elicit adaptations that may facilitate uptake from the provider perspective [40].

To address these gaps in the literature, we sought to develop an mHealth intervention that provides psychiatric care providers with clinically relevant and time-sensitive information that would enhance MBC, better inform decisions regarding treatment and medication management, and improve therapeutic relationships and SDM. Prior research has demonstrated the benefits of soliciting stakeholder input when developing and refining mHealth apps, including for individuals with schizophrenia [19] and early psychosis [22,31,41]. For example, Ben-Zeev et al [19] used a multistage, multistakeholder input and feedback approach combining survey and qualitative methods to develop the FOCUS app that supports self-management for people with schizophrenia. Similarly, within an early intervention service for psychosis, McClelland and Fitzgerald [41] conducted a staged series of focus groups with patients and clinicians to develop an app that helped patients track their mood and activities, receive reminders and messages, and seek external support.

In this study, we described the systematic process of soliciting inputs from clinician stakeholders to develop and adapt an app as part of a pilot study examining the implementation of a community-based FEP mHealth intervention for adolescents and young adults. As our app focuses on a novel clinical target, the information available to clinicians, and its use in SDM, the views and input of clinicians were critical for elucidating this target. Adaptations may entail changes to interventions, or to implementation strategies, that produce better alignment with factors such as the needs, resources, and cultures of target settings and populations [42]. Specifically, such input may lead to adaptations in multiple aspects of an intervention, including content, frequency, and timing, which may then improve intervention fit (eg, appropriateness), feasibility (eg, successful delivery), acceptability (eg, satisfactoriness), and effectiveness, given a particular practice setting and population served or higher-level contextual factors such as local policies [43]. Changes to implementation strategies can include adding intervention training or modifying workflows, as these focus on methods and activities that seek to maximize the extent to which an intervention is adopted, used, and sustained within routine practice [44]. Overall, adaptations may address several considerations, including clinical judgment, stakeholder preferences, and perception of the intervention, as well as factors associated with the entity or setting (eg, clinic) within which the intervention is embedded, such as an organization's access to resources, social context, or mission. Finally, adaptations can also be responsive to the wider sociopolitical context, such as social norms or mores, and funding policies.

In addition to the practical value of obtaining stakeholder input for intervention design, there are increasing calls for the development, tracking, and reporting of processes and findings regarding adaptations to interventions and implementation strategies as part of efforts to disseminate methods, tools, and resources that promote rapid and iterative applications of implementation science and translational research [45]. One such tool is the Framework for Reporting Adaptations and Modifications - Enhanced (FRAME) [46,47]. It facilitates the ability of researchers and providers to capture a range of information relevant to adaptation decision-making processes and to catalog ways in which a practice has changed from a previously established iteration or protocol. The FRAME allows for systematic classification of intervention adaptations by guiding researchers and providers to address key questions such as (1) when adaptations are made; (2) who participated in the decision-making process; (3) specifically, what was modified or adapted and to which aspect of the intervention does it relate (eg, context and content); (4) the reasons why an adaptation was made; (5) the goal of the adaptation (eg, increase reach or engagement); and (6) whether the adaptation is consistent with intervention fidelity or an intervention's core principles.

Methods

Context and Setting

This qualitative study was conducted as part of a pilot randomized controlled trial (RCT) to evaluate the feasibility and acceptability of using First Episode Digital Monitoring (FREEDoM), a novel mHealth app designed to enhance MBC and SDM, as well as improve patient satisfaction with pharmacotherapy regimens at 3 clinics delivering coordinated specialty care (CSC) [48,49] for patients with FEP (ClinicalTrials.gov NCT04248517). The clinics, all affiliated with OnTrackNY, provide treatment to adolescents and young adults (aged 16-30 years) experiencing nonaffective FEP [44]. OnTrackNY originated as part of the National Institute of Mental Health Recovery After an Initial Schizophrenia Episode Implementation and Evaluation Study. The CSC programs use an evidence-based, multidisciplinary, and team-based approach that offers pharmacotherapy, psychotherapy, supported employment and education, and peer support and emphasizes an SDM approach to treatment [50]. Semistructured qualitative interviews were conducted with CSC program staff (eg, psychiatric care providers and primary therapists) before initiating the RCT at each site to elicit provider perspectives on the proposed intervention and plans for implementation. Researchers used provider feedback from structured interviews and the FRAME to identify, catalog, track, and implement adaptations to increase the potential feasibility and acceptability of the RCT intervention and protocol.

FREEDoM—a Novel mHealth Intervention

The FREEDoM mHealth intervention project involved patients completing 3-day ESM-based assessments once per month immediately before their appointment with their psychiatric care provider of the CSC program. The goal of the intervention was to provide timely, accurate, and granular information about clinical status; improve communication about pharmacotherapy between patients and clinicians; enhance SDM; and improve patient treatment satisfaction.

During the 3-day assessment, the mHealth app delivered notifications to the participants' smartphones 10 times a day at random times between 10 AM and 10 PM to complete brief

questionnaires. Participants had 15 minutes to begin responding to questions presented on the smartphone's screen. The questions asked during each sampling assessment varied based on the time of day and a system of branching logic within each set of questions. The first daily questionnaire included questions about sleep and medications taken the previous day. The middle 8 questionnaires asked about psychiatric symptoms, medication side effects, mood, substance use, social activities, and context, as well as activities and difficulties functioning. The final questionnaire each day asked about side effects that are less transient (eg, constipation and sexual side effects), as well as global functioning. Each questionnaire took 3 to 5 minutes to complete. Following the 3-day ESM assessment, the clinician received a 1-page succinct report summarizing key clinical variables characterizing the current status and functioning of the patient, along with changes from the previous month and the start of the study that could be reviewed and discussed with the patient in the upcoming session. Clinicians were encouraged to share the reports with their patients during clinical sessions and use them as a basis for discussions on clinical status, treatment goals, clinical progress, and SDM.

Sample

A purposive sampling approach was used to identify staff members at each CSC site whose primary role was to provide clinical care to patients. Team leaders served as initial key informants at each site and nominated a psychiatric care provider (either a physician or nurse practitioner) and other clinical staff members, whom they believed would contribute feedback relevant to the proposed intervention and implementation plan, for study participation. All staff members identified for the interviews provided informed consent and participated in the study.

Data Collection

The initial development of the questions and inquiry items included in the FREEDoM app was completed by DK and TSS, with the team members providing additional edits. Next, the CSC providers completed individual semistructured interviews lasting approximately 1 hour each. Interviews were conducted by 2 senior MD or PhD clinician researchers (TSS and DK) who were trained and supported by 2 experts in qualitative methods and implementation science (LJC and AS). The first 2 interviews were conducted in-person before the COVID-19 pandemic restrictions, and subsequent interviews were conducted via videoconferencing (eg, via Zoom) owing to social distancing mandates. Interview guides (Multimedia Appendix 1), which were developed collaboratively by the research team, were framed to inquire about providers' perspectives on study procedures related to implementation, recruitment, and retention, as well as feedback on the content and structure of both the FREEDoM mHealth app used to deliver the proposed intervention and the report delivered to clinicians. During the interviews, providers were shown screenshots of the mHealth app and a draft of the 1-page clinical report for feedback. The interviews were audio-recorded, transcribed verbatim, reviewed for accuracy, and deidentified.

Pragmatic Data Analysis Procedures

Data analysis and deliberation of adaptations were performed in tandem with data collection (Figure 1). Data were analyzed using a summary template and matrix analysis approach to categorize suggested adaptations using key dimensions of the FRAME. Matrix analysis is a rigorous but pragmatic method for rapidly extracting and reducing qualitative data, allowing researchers to systematically synthesize and catalog content into a template of key topics [51-53].

Following the semistructured interviews, one author (RTR) developed draft interview summaries of each transcript, extracting interview content based on key interview topics. These summaries were then edited by a senior author (AS) with expertise in qualitative analysis to ensure that all information pertinent to potential adaptations from each transcript was captured in the summary. Summaries included providers' assessment of procedures or content (eg, endorsed or had concerns) and systematically outlined each suggested adaptation along with illustrative quotes.

Next, brief descriptions of the suggested adaptations and relevant contextual information from the summaries were entered into a descriptive adaptation matrix (Table 1). The adaptation matrix was a Microsoft Excel table template with column headings representing information that would be needed to classify adaptations along FRAME domains (the adaptation suggested, supporting rationale or contextual information, whether adaptations would vary by study site, and key quotes) and rows outlining potential adaptations organized by project components (eg, "project implementation issues," "app-related," and "report-related") with specific subtopics (eg, "mobile phone and data plan reimbursement" was a subtopic of "project implementation issues"). During this charting process, the authors met every other week to discuss the suggested adaptations and deliberate making changes. Decisions on whether to implement a suggested adaptation were documented by 1 author (RTR) in the adaptation matrix along with a brief description of why the adaptation was incorporated.

Figure 1. Pragmatic analysis for rapid qualitative research. FRAME: Framework for Reporting Adaptations and Modifications-Enhanced.

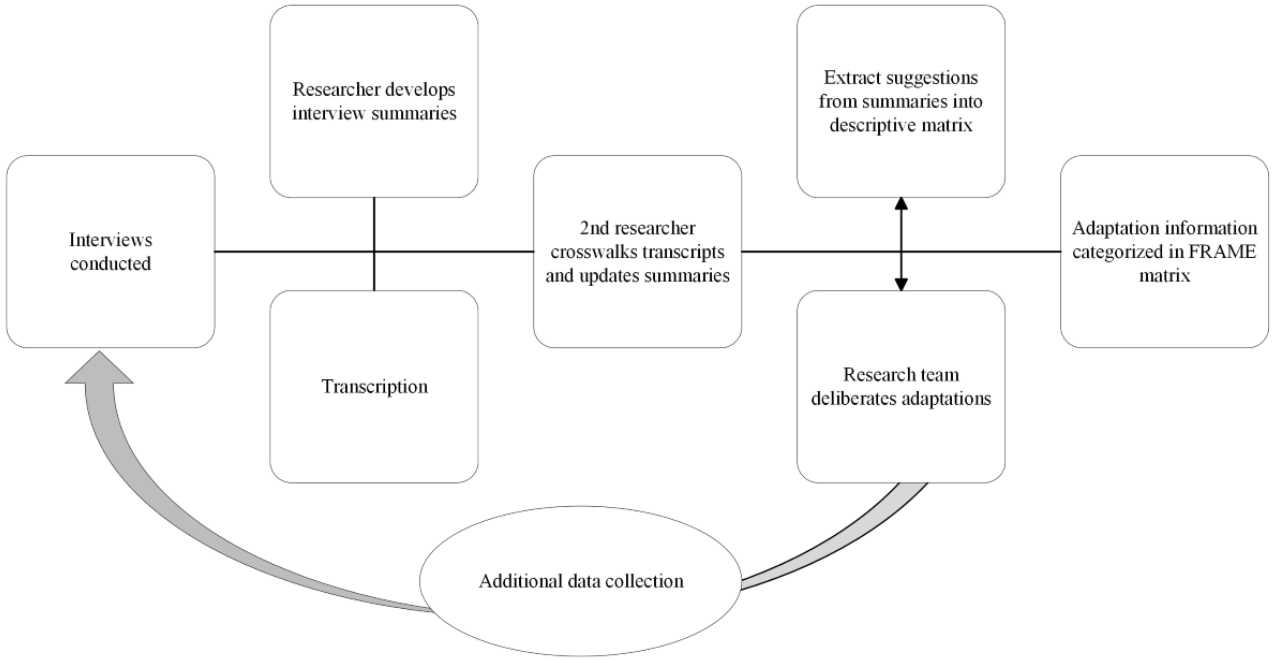

Table 1. A sample descriptive adaptation matrix mobile health First Episode Digital Monitoring.

Domain	Stakeholder input and feedback	Suggestion for adapted practice	Varies by site	Relevant stakeholder quote	Adaptation implemented
App-related					
Questions or content	Current app content is fine, but weight gain should be added as a side effect	Add weight gain to the app questions	No	"Would you consider adding weight gain to the list of side-effects? Because that's been something that has been brought up by some participants in the past and the prescriber really tries to, to work with them on that."	Yes
Pinging and frequency	10 pings a day may be too much	Reduce pings per day	N/A[a]	"I'm just curious if like if you're in college, you're in high school; like how realistic is it that you're going to be...? I don't know what's the frequency..."	No
Report					
Layout or design	Inclusion of daily averages is useful	Include daily averages in granular graph	No	"I like having the average for the day."	Yes
Access to report	It would be helpful for participants to receive a report of their answers within the app itself	Consider providing report directly to participant	No	"Just wondering, like are, are participants able to get like information like this?... like maybe like since it's an app like they're able to like see what they said and like past months."	No, consider for future iteration
Content	Caffeine should be included owing to its effects on sleep	Include caffeine as a substance	No	"[Caffeine and other substances] are relevant for sleep."	Yes

[a]N/A: not applicable.

After all the suggested adaptations were entered into the descriptive adaptation matrix, each adaptation was further classified along FRAME domains that were applicable to tracking planned adaptations before implementation for interventions without established fidelity standards (what was modified at what level of delivery, type of contextual adaptation, nature of content modification, reason for adaptation and goal). The FRAME organizes the reasons why an adaptation is made into 4 overarching categories: recipient, provider, organization, or sociopolitical context, with specific subcategories. An additional subcategory was developed and added under participant-level reasons for adaptation that emerged from the data—"Health narratives and priorities"—to reflect the adaptations that sought to be more responsive to participants' understanding and perspectives on their needs and mental health. Descriptive reasons for not implementing the suggested adaptations were further classified into categories inductively developed by the researchers. To organize and streamline findings, the adaptations were clustered by the reason for suggesting them and by whether or not the suggestion was

adopted. Strategies for maximizing rigor included progressively reducing the data using a series of defined steps (eg, transcribing, summarizing, charting, and categorizing); using multiple researchers at each step to extract, reduce, and categorize the data; conducting frequent debriefing meetings throughout data collection and analysis; and keeping an audit trail [54,55].

Ethics Approval

All the procedures were approved by the Institutional Review Boards of the New York State Psychiatric Institute (#7900) and Northwell Health (#20-0429).

Results

Overview

A total of 11 CSC clinical providers completed the semistructured interviews: 4 staff members each at 2 sites and 3 staff members at a third site. The interviewed staff members represented different disciplines and clinical roles on the treatment team, including team leaders (3/11, 27%), psychiatric care providers (eg, psychiatrist and nurse practitioner; 5/11, 45%), and primary therapists (eg, clinical social workers; 3/11, 27%). In total, the staff members suggested 31 adaptations (Tables 2 and 3): twenty-four were regarding the intervention itself (eg, app questionnaire and data reports), and the remaining 7 were regarding implementation strategies (eg, reiterating instructions and checking smartphone compatibility). Suggestions to modify content were the most frequent (18/31, 58%) and focused on adding or refining content, such as including new survey questions or displaying additional data in the report. This was followed by suggestions for context modification (13/31, 42%), including aspects of format, such as the design of the report, and aspects of the population, such as which staff should have access to the report. Reasons for suggesting modifications included responsiveness to factors at the participant (15/31, 48%), provider (11/31, 35%), organization or setting (3/31, 10%), and sociopolitical (2/31, 6%) levels. Overall, the goals of the suggested adaptations were to improve the fit with recipients or to increase satisfaction, effectiveness, feasibility, reach, and engagement. Ultimately, 58% (18/31) of suggestions were implemented within the study and applied across all sites (ie, adaptations were not specific to or varied by site), whereas 42% (13/31) were not adopted.

Table 2. Summary of adaptations suggested and accepted for mobile health First Episode Digital Monitoring.

Reason for suggested adaptation	Goal was to increase or improve	What was suggested and adapted	Type of adaptation made
Recipient level			
Health narratives and priorities			
Time burden	Fit with recipients, feasibility	Repeat or reassure that skipping some questionnaires is OK	Implementation strategy: content-repeating
Privacy or confidentiality	Reach and engagement	Repeat information regarding confidentiality	Implementation strategy: content-repeating
Person-centered care	Fit with recipients, satisfaction	Report: use person-centered, experience-based language vs medicalized language	Content: tailoring or tweaking or refining
Recovery-oriented approach	Fit with recipients, satisfaction	App: ask how bothersome symptom is and impact on functioning	Content: adding elements
Access to resources			
Technology	Reach and engagement, feasibility	Check smartphone compatibility before enrollment	Implementation strategy: context, format
Crisis or emergent circumstance			
Participant safety	Fit with recipients	Include suicidal ideation as exclusionary criteria	Context: population
Comorbidities			
Multiple mental health symptoms or conditions	Effectiveness	Clarify instructions to include multiple psychiatric medications	Implementation strategy: content-tailoring or tweaking or refining
Physical health side effects	Fit with recipients, satisfaction	App: ask about weight gain as potential side effect	Content: adding elements
Provider level			
Clinical judgment			
Clinically meaningful information	Satisfaction, effectiveness	App: ask about timing of medication use and factor in for adherence	Content: adding elements
Clinically meaningful information	Satisfaction, effectiveness	Report: include substance use and caffeine use on report	Content: adding elements
Clinically meaningful information	Satisfaction, effectiveness	Report: include lines for daily averages on report's granular graphs	Content: adding elements
Previous training or skills	Feasibility	Train providers to read report and include legend	Training content: adding elements
Preferences			
Data visualization	Satisfaction	Report: reduce report or graph density (eg, focus on subset of symptoms or side effects)	Context: format
Data visualization	Satisfaction	Report: use dots on report's granular graphs	Context: format
Organization level			
Service structure			
Team-based care	Feasibility, effectiveness	Option to share report with multiple staff	Context: personnel
Mission or culture			
Shared decision-making	Satisfaction, effectiveness	Option for clinician to show report to the participant	Context: format
Sociopolitical level			
Existing policies			
COVID-19 pandemic social distancing mandates	Reach and engagement	Attend web-based program meeting for introduction or warm handoff to client for recruitment	Implementation strategy: context, format
COVID-19 pandemic social distancing mandates	Reach and engagement	Option to receive an e-gift card as participant reimbursement	Implementation strategy: context, format

Table 3. Summary of adaptations suggested and rejected for mobile health First Episode Digital Monitoring.

Reason for suggested adaptation	Goal was to increase or improve	What was suggested, but not adapted	Type of adaptation not made	Reason why adaptation not made
Recipient level				
Health narratives and priorities				
Time burden	Fit with recipients, feasibility	Reduce ping frequency	Content: shortening or condensing (pacing or timing), tailoring	Compromises core components
Time burden	Fit with recipients, feasibility	Tailor ping timing around participant work or school hours	Content: shortening or condensing (pacing or timing), tailoring	Increases complexity
Privacy or confidentiality	Reach and engagement	Offer non–app-based means of collecting information	Context: format	Beyond intervention scope
Person-centered care	Fit with recipients, satisfaction	App: ask more positively worded questions	Content: adding elements	Increases recipient time burden
Person-centered care	Fit with recipients, satisfaction	Ask more open-ended questions	Content: adding elements	Increases complexity of data or report
Access to resources				
Technology	Reach and engagement, feasibility	Provide phones to participants	Implementation strategy: content, adding	Additional resources required (as well as in-person meeting during COVID-19 pandemic)
Literacy or education level				
Data visualization	Fit with recipients	Report: simplify report so participants can understand it more easily	Content: tailoring or tweaking or refining	Compromises core components (may reduce usefulness to providers as primary targets)
Provider level				
Clinical judgment				
Clinically meaningful information	Satisfaction, effectiveness	App: ask more about negative symptoms	Content: adding elements	Beyond intervention scope and increases time burden
Clinically meaningful information	Satisfaction, effectiveness	App: ask about suicidal ideation	Content: adding elements	Additional resources required
Clinically meaningful information	Satisfaction, effectiveness	Allow providers to access more information than what is on the report	Content: adding elements	Additional resources required
Clinically meaningful information	Satisfaction, effectiveness	Collect data on days more removed from clinical session	Content: lengthening or extending (pacing or timing)	Beyond scope
Preferences				
Data visualization	Satisfaction	Report: use bars on granular graphs	Context: format	Not consistent with most clinicians' preferences
Organization level				
Mission or culture				
Shared decision-making	Satisfaction, effectiveness	Send report or information directly to participant	Context: format	Additional resources required and beyond intervention scope

Adaptations Suggested and Adopted

Adaptations for Participant-Level Reasons

Adaptations that were ultimately adopted were most commonly driven by reasons at the participant level and included the need to address factors such as participants' health narratives and priorities, comorbidities, access to resources, and safety. With respect to health narratives and priorities, the most substantive changes were to refine or add intervention content. Staff members emphasized the need to use person-centered and experience-based language, instead of medical language, throughout the intervention, including changing data labels on the report (eg, changing "symptoms" to "experiences" and "hallucinations" to "seeing things"; Multimedia Appendix 2):

> *[It's important that the] language be recovery-oriented...[many participants] don't agree with our diagnosis. So that's why it's important for us to be able to engage them. It can't always be-reflect the language of sort of traditional medical model.* [P6]

Beyond refining the wording, staff members highlighted the need for additional app questions that would incorporate participants' own perceptions of their mental health in a more person-centered and recovery-oriented way, potentially making the questionnaire more engaging and relevant to the participants. Suggestions that were adopted included adding questions that would not only assess the frequency of symptoms or side effects but also to inquire the degree to which participants perceived these experiences to be bothersome or interfering in their functioning (ie, how much "[This Experience] gets in the way of what I'm doing"):

> *Particularly for our population, it's really not about whether or not they have a symptom... It's really about if that symptom is getting in the way of something...our young people don't in general tend to like apps that remind them or conceptualize them as being sick... asking things in a way that might be a little more recovery-oriented might be helpful..."If you do experience this, can you tell us...how much is this thing particularly bothersome or impacting your ability to do the things that you want to do whether you work or school"...That way the person could experience it as, "yes I have voices, but no, it's actually not impacting me" or if something is interrupting your life, it might help you to remind yourself, "okay, this actually is a problem."* [P6]

Staff members also noted the need to add questions that would further reflect priorities of the recipients; for example, asking about side effects that were of known concern to them, as subsequently included in the app:

> *Would you consider adding weight gain to the list of side-effects? Because that's been something that has been brought up by some participants in the past and the prescriber really tries to... work with them on that.* [P3]

Staff members also identified the need to reassure participants of confidentiality and voluntariness by repeating content, such as reiterating instructions regarding confidentiality and the ability to skip app questions. Finally, to address concerns regarding participant safety, study exclusionary criteria were modified to include suicidal ideation, whereas concerns regarding the participants' access to technology were addressed by adding a step to check participants' smartphone compatibility with the app before enrollment.

Adaptations for Provider-Level Reasons

Reasons at the provider level included factors such as clinical judgment, previous training or skills, and provider preferences. Most commonly, this entailed suggestions for adding questions to the app or presenting additional data in the report to maximize access to information that providers believed to be clinically meaningful. This included requests for the report to display specific substances beyond illicit drugs (eg, caffeine) that can impact participants' functioning and for the app questionnaire to account for different factors that have a role in medication adherence (eg, route of administration and timing):

> *It doesn't capture what substance was used. You would have to ask...maybe code each [substance in the report]...show [the participant]...had a cup of coffee...[Caffeine and other substances] are relevant for sleep.* [P1]

> *What if the patient's on a (Long Acting Injectable), like an antipsychotic, how would you capture that?...What if they [were supposed to take] the medication in the morning, but took it in the afternoon...* [P11]

Suggestions for how best to depict data in the report generally reflected provider preferences for visualizing data in a certain format to enhance readability or to reduce the density of graphs (eg, display only the subset of symptoms and side effects with highest impact or severity) owing to concerns that the report was "a little overwhelming...lots of bars...the page is completely full." In addition, enhancing training for providers in interpreting reports was identified and incorporated as a key implementation strategy:

> *At first when I saw the report I'm like, "oh, my gosh, all these dots, all these numbers," but...you guys [actually] explaining it to me...I feel like it's really simple...* [P3]

Adaptations for Organization-Level Reasons

Regarding reasons associated with the organization or setting, adaptations were suggested to better align the project with key aspects of the mission or culture of the CSC programs and team service structure, specifically SDM and the use of a team-based approach. For example, staff members suggested that they could show the report to participants during sessions, using it as a "visual" tool for promoting participant engagement and informing SDM processes (eg, discussing options, tailoring pros and cons, and exploring patient fears or expectations):

> *I could totally see using it. I'm all about transparency. So I would show [the report] to them, and I would try to explain it and everything. "And this is what the data says..." in terms of engaging them into their treatment, it'll help with that...this is...shared decision making. And this gives them more of a connection and participation in their treatment.* [P1]

Furthermore, given the multidisciplinary and team-based approach of the CSC programs, providers emphasized that team members other than the psychiatric care provider should have access to the report, which was integrated as an option:

> *Since we are a team and we talk very openly about each participant...I think all of our team members should get [the report]...it would be like a comprehensive way to say...this person is...experiencing this and this, experiencing this kind*

> *of side-effects, and then we can get together as a team about it during our meeting.* [P8]

Adaptations for Sociopolitical Context–Level Reasons

Finally, to respond to the sociopolitical context, adaptations to implementation strategies were suggested to address some of the barriers related to COVID-19 pandemic social distancing mandates. Given the limited in-person services, staff members noted the need to expand options for reimbursing participants (eg, offering electronic gift cards) and for preserving aspects of a warm handoff when linking participants to researchers by adding the option of a web-based handoff:

> *To introduce the [participant]...we are able to do groups via the [virtual] platform. So if the participant is able to go onto the platform and do our video session...if they agree, [the research assistant] can join and it will be the three of us.* [P8]

Adaptations Suggested but Not Adopted

Of the 31 suggestions, 13 (48%) adaptations were ultimately not implemented, which generally reflected suggestions to add content by collecting additional information through the app questionnaire, to adapt aspects of context to facilitate participants' direct access to and understanding of their own data, and to change the pacing or timing of the intervention components. Overall, the reasons for suggesting these adaptations reflected rationales similar to those behind the adaptations that were made, with responsiveness to health narratives and priorities of the participants and clinical judgment of the providers once again being the most frequent. The reasons that researchers did not incorporate these suggested adaptations included additional study resources being required, modifications being beyond the scope of the intervention, concerns regarding compromising core components or mechanisms, managing intervention complexity, managing participant time burden, and adaptations not being consistent with the preferences of most providers. The staff suggested additional questionnaire content, such as asking more about negative symptoms and positive experiences or adding open-ended questions, primarily as a potential way to make the app more engaging for participants:

> *But it will also be nice to, towards the end, to say oh, "but you did report this other positive thing that happened to you." Or so it's just not about medication.* [P10]

Although researchers acknowledged the potential value of collecting this additional data, these additions were ultimately not made owing to concerns that they were outside the primary scope of the pilot trial, would pose an increased time burden for participants, or would unacceptably increase the complexity of the data presented in the report.

The staff also expressed concerns about different aspects of intervention timing, inquiring "how realistic" it was for participants to respond to 10 questionnaires a day, with suggestions to reduce or tailor questionnaire frequency. There was also provider uncertainty about the timing of data collection, with suggestions to space out participant completion of questionnaires and to include time points further removed from upcoming appointments to potentially capture experiences that may also be relevant but more challenging to remember:

> *Is there an opportunity to have flexibility with what three days are selected...As opposed to the last three days before they're seeing me...answering those questions [at different points] in real time further away from my appointment...I could see sometimes where [the past three days] might matter, if there's something they want to talk about in their experience more recently. I can see sometimes where it's not as relevant.* [P6]

These changes to intervention timing were not adopted, with researchers seeking to preserve the core component of 10 ESM questionnaires based on their prior experience of high frequencies yielding adequate response rates [13], and tailoring questionnaire frequency to participants' changing schedules was too complex to be reliably implemented over time.

Providers also suggested offering alternative means for participants to complete the questionnaire, offering smartphones to participants lacking the technology, as well as providing participants with direct access to their own data and further simplifying the report to make it easier for participants to understand:

> *Is there an option if participants are hesitant about downloading an app, like a way to do it by email...* [P2]

> *It would be nice if when you're with a particular client to simplify these graphs. Because if you are going to use it as a tool, like this most people would not understand.* [P10]

Although these suggestions had the potential to expand intervention reach and enhance participant engagement with the intervention and their own data, they were ultimately not adopted. Researchers determined that offering a non–app-based means of collecting data was beyond the scope of the mHealth intervention and that tailoring the report to participants versus providers could result in a loss of information that potentially compromised core components. Moreover, purchasing smartphones would require additional funding.

Discussion

Principal Findings

This study presents our process and findings of using rapid and pragmatic qualitative methods along with the FRAME to systematically solicit, document, deliberate, and report provider-suggested adaptations to FREEDoM, an mHealth app aimed at enhancing treatment for individuals with FEP. This study is one of only a handful of published reports characterizing efforts to incorporate direct stakeholder input (eg, clinicians) into the development process of an app targeting treatment of psychosis and the first to focus on enhancing the therapeutic relationship and improving SDM among patients with FEP and their treatment teams.

With overarching research questions guided by the FRAME, we conducted focused semistructured interviews while

concurrently extracting data from transcripts to interview summaries and then to a descriptive matrix, further condensing the data at each step until we categorized each adaptation along the FRAME domains. This study demonstrates how these methods can facilitate rapid analysis of qualitative research data for intervention adaptation and yield timely findings with high clinical relevance to inform the delivery of care.

Reasons for suggesting adaptations most commonly included responsiveness to health narratives and priorities of patients, clinical judgment of providers, and mission or culture of organizations. Suggestions to add or refine content were most common, including asking participants to rate how bothersome symptoms or side effects were, rewording the report to be person centered and experience based in lieu of medical language, and presenting additional data in the report. Adaptations to context were most often related to an implementation strategy (eg, web-based handoffs during recruitment), the format of the provider report, and with whom the report was shared.

Overall, the adaptations that were suggested and adopted were driven by key aspects of the CSC context to shift the intervention to better reflect the needs and preferences of the population served and the CSC's emphasis on SDM, recovery-oriented practice, and team-based approach to care. In particular, asking additional questions and changing the phrasing of report labels sought to address factors such as patients' perceptions of their mental health conditions, priorities, and existing comorbidities. The inclusion of additional questions also addressed providers' need for more comprehensive and clinically relevant information, as did changes to which data were displayed and how the report was designed. Adaptations implemented also responded to key aspects of the structure, mission, and culture of the CSC programs. For example, the CSC team-based approach to care necessitated the option of sharing the report across providers, whereas the option to review the report collaboratively with participants during a session aligned with SDM. This adaptation to share the report with other providers and patients, as well as the inclusion of patients' perceptions of the impact of symptoms on functioning, may be particularly important to counteract the potential tendency of any one provider to narrowly interpret or selectively focus on certain data, given their particular role, background, or training. Although not fully eliminating factors such as providers' information selection bias, incorporating patients' ratings of functioning and having multiple individuals review and discuss the report, including the patients themselves, may help bridge the gap between what patients and any one provider might perceive as important, relevant, or possible, potentially enhancing SDM.

Adaptations that were suggested but not incorporated most frequently reflected suggestions to collect additional patient information, facilitate patients' access to their own data, or change the timing of the intervention components. The fact that the rationales for suggesting these adaptations, which were ultimately not made, were generally similar to the those for implemented adaptations indicates that the adaptation decision-making process—whether to adapt or not—did not appear to exhibit a systematic bias (eg, consistently rejecting adaptations reflecting participant-level compared with provider-level factors). Suggested adaptations were not incorporated into the intervention when the research team deemed that they were outside of the current aims or scope of the trial, potentially compromised core components or mechanisms or that they presented a feasibility challenge such as insufficient resources to implement an adaptation in the context of a pilot trial or increased complexity.

The tracking of adaptations not made further helps to highlight key dilemmas that may frequently emerge when deliberating mHealth adaptations within clinical care. For example, in this study, researchers had to weigh the potential benefit of the providers' suggestion that participant engagement could be encouraged by including more positively worded statements or open-ended questions in the app against the potential drawback of increased time required to complete questionnaires, which might discourage participant engagement. Ultimately, the decision was made to not include these extra questions, given that the potential net impact on engagement was unclear. In addition, it hindered the study's ability to expeditiously produce short 1-page clinician reports by having to process and include additional items and free text entries, which would also potentially increase the amount of time that clinicians would need to review a more complex report. Such deliberations illustrate how decision-makers may have to discern how best to balance factors such as the desire to potentially create a more engaging app while not sacrificing feasibility by inadvertently creating an excessive time burden for patients or clinicians. Future studies can further identify the information that decision-makers consider when weighing these factors and explore the feasibility of empirically pretesting different iterations of an intervention when the evidence to support an adaptation decision is unclear. For example, with adequate time and resources, 2 versions of an app could be tested—one with and one without the positive and open-ended questions—providing an empirical basis upon which to accept or reject this suggestion, depending on the respective rates of participant engagement. Overall, tracking adaptations not made provides greater insight into the dilemmas and decision-making processes of intervention adaptation while also offering concrete suggestions that can be considered for future refinement of similar mHealth interventions. Proposing preliminary categories for reasons why adaptations are not made represented the first step toward providing guidelines to standardize this process.

Overall, health care systems and workflows often vary dramatically, necessitating consideration of whether to integrate uniform and standardized interventions or shape interventions around specific aspects of local contexts, for example, the needs, preferences, and training backgrounds of providers in any setting. Adapting interventions to certain contexts and providers may yield several benefits, such as increased intervention uptake, satisfaction, and effectiveness. However, the challenges in engaging in the process of intervention adaptation include the extra time, resources, and expertise required to solicit stakeholder input and make adaptations. By illustrating some of the tools and rapid approaches used in this study, we seek to help minimize some of these challenges.

Limitations

This study has several limitations. Although CSC providers with different clinical roles were interviewed, the inclusion of other provider roles representing nonclinical staff (eg, peer specialist and supported employment specialist) could have yielded additional information relevant to adaptation, particularly given the team-based approach of CSC programs. The inclusion of CSC patients was originally planned as part of stakeholder interviews (to be published in a separate manuscript); however, the onset of the COVID-19 pandemic and the enactment of social distancing mandates coincided with the start of the study and interfered with patient data collection. Given that implementation barriers identified by patients and providers can be different, the inclusion of CSC patients would likely have identified additional suggestions that either expanded upon or potentially conflicted with the feedback offered by providers. Future studies, including our pilot trial of the developed FREEDoM app, which includes both stakeholder perspectives, can also offer insights into how best to balance or reconcile suggested adaptations that differ or conflict between patients and providers. Nevertheless, by soliciting CSC clinicians' perspectives, this study addressed a key gap in the literature regarding providers' information needs and strategies that may promote mHealth integration into early psychosis treatment. This gap is particularly important to address given the overarching concerns regarding providers' buy-in for, and use of, patient-generated data in health care more broadly [40]. In addition, although our study contributes to the current understanding of provider preferences regarding MBC within early psychosis treatment and how to deploy mHealth technologies, it represents only an initial step, with much work remaining to identify the factors that influence long-term implementation, acceptability, and sustainability.

By virtue of the research objective, identified adaptations reflect the context of participating CSC programs and the scope of a subsequent clinical trial seeking to provide clinicians with patient information that may impact pharmacological treatment decisions. However, CSC is an established evidence-based practice with well-articulated core components that may support broader applicability of our findings, including a team-based approach, a wide range of multidisciplinary services (eg, psychotherapy, pharmacotherapy, and primary care coordination; supported employment and education; family education and support; and case management), and person-centered, recovery-oriented treatment that emphasizes SDM. In addition, although all 3 CSC study sites were in urban areas and had their fidelity to the model monitored, adaptations were uniform across sites despite variability along other key dimensions, such as the type of organization operating the program (eg, affiliated with a community-based nonprofit organization vs a hospital), aspects of population served (eg, ratio of more newly enrolled CSC patients to more established patients), and psychiatric or medical staffing (eg, nurse practitioner or psychiatrist, one or multiple psychiatric providers on team). Although this suggests the potential for broader generalizability of findings across CSCs, the adaptations may not be applicable for settings using mHealth data for a different purpose or to CSC programs that substantially depart from the model's core functions and components, particularly those that may not adopt the recovery-oriented, person-centered, and SDM approaches that drove many of the adaptations suggested in this study. Finally, the study focused on adaptations suggested before intervention implementation; therefore, results from ongoing clinical trials are needed to evaluate the implementation and effectiveness of the developed mHealth intervention.

Conclusions

This study illustrates a pragmatic and rapid application of the FRAME to track provider-suggested adaptations to FREEDoM, a novel mHealth intervention app, and its implementation within "real-world" FEP treatment programs. The methodology used in this study offers a rigorous, iterative, and rapid approach to solicit, analyze, and incorporate qualitative stakeholder inputs for the development and adaptation of clinical interventions. Systematic tracking of suggested adaptations, including which adaptations were ultimately not implemented (and why), is essential to understanding and enhancing key implementation indicators such as intervention fit, feasibility, and acceptability while also increasing transparency and accountability in the adaptation decision-making processes. The FREEDoM app seeks to enhance the therapeutic relationship and improve SDM between patients with FEP and their treatment teams. Future studies should characterize relevant clinical findings, including measures of therapeutic relationships and SDM.

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Authors' Contributions

DK, TSS, LJC, and AS conceptualized and designed the study. RTR, XX, and RB assisted with data collection, visualization, and coordination. AS, RTR, LJC, TSS, and DK analyzed and interpreted the qualitative data. AS and RTR drafted the initial manuscript, and SS, IL, LJC, TSS, and DK provided the edits. All authors have read and approved the final manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Clinician qualitative interview.
[PDF File (Adobe PDF File), 38 KB - mental_v9i11e41482_app1.pdf]

Multimedia Appendix 2
Sample participant mobile health reports.
[DOCX File , 255 KB - mental_v9i11e41482_app2.docx]

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Abbreviations

CSC: coordinated specialty care
ESM: experience sampling method
FEP: first-episode psychosis
FRAME: Framework for Reporting Adaptations and Modifications ‐ Enhanced
FREEDoM: First Episode Digital Monitoring
MBC: measurement-based care
mHealth: mobile health
RCT: randomized controlled trial
SDM: shared decision-making

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Review

Implementation of e–Mental Health Interventions for Informal Caregivers of Adults With Chronic Diseases: Mixed Methods Systematic Review With a Qualitative Comparative Analysis and Thematic Synthesis

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Abstract

Background: Informal caregivers commonly experience mental health difficulties related to their caregiving role. e–Mental health interventions provide mental health support in a format that may be more accessible to informal caregivers. However, e–mental health interventions are seldom implemented in real-world practice.

Objective: This mixed methods systematic review aimed to examine factors associated with the effectiveness and implementation of e–mental health interventions for informal caregivers of adults with chronic diseases. To achieve this aim, two approaches were adopted: combinations of implementation and intervention characteristics sufficient for intervention effectiveness were explored using qualitative comparative analysis, and barriers to and facilitators of implementation of e–mental health interventions for informal caregivers were explored using thematic synthesis.

Methods: We identified relevant studies published from January 1, 2007, to July 6, 2022, by systematically searching 6 electronic databases and various secondary search strategies. Included studies reported on the effectiveness or implementation of e–mental health interventions for informal caregivers of adults with cancer, chronic obstructive pulmonary disease, dementia, diabetes, heart disease, or stroke. Randomized controlled trials reporting on caregivers' mental health outcomes were included in a crisp-set qualitative comparative analysis. We assessed randomized controlled trials for bias using the Risk of Bias 2.0 tool, and we assessed how pragmatic or explanatory their trial design was using the Pragmatic Explanatory Continuum Indicator Summary 2 tool. Studies of any design reporting on implementation were included in a thematic synthesis using the Consolidated Framework for Implementation Research to identify barriers to and facilitators of implementation.

Results: Overall, 53 reports, representing 29 interventions, were included in the review. Most interventions (27/29, 93%) focused on informal cancer or dementia caregivers. In total, 14 reports were included in the qualitative comparative analysis, exploring conditions including the presence of peer or professional support and key persuasive design features. Low consistency and coverage prevented the determination of condition sets sufficient for intervention effectiveness. Overall, 44 reports were included in the thematic synthesis, and 152 barriers and facilitators were identified, with the majority related to the intervention and individual characteristic domains of the Consolidated Framework for Implementation Research. Implementation barriers and

facilitators in the inner setting (eg, organizational culture) and outer setting (eg, external policies and resources) domains were largely unexplored.

Conclusions: e–Mental health interventions for informal caregivers tend to be well-designed, with several barriers to and facilitators of implementation identified related to the intervention and individual user characteristics. Future work should focus on exploring the views of stakeholders involved in implementation to determine barriers to and facilitators of implementing e–mental health interventions for informal caregivers, focusing on inner and outer setting barriers and facilitators.

Trial Registration: PROSPERO (International Prospective Register of Systematic Reviews) CRD42020155727; https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020155727

International Registered Report Identifier (IRRID): RR2-10.1136/bmjopen-2019-035406

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KEYWORDS

informal caregivers; e–mental health; implementation; chronic diseases; systematic review; thematic synthesis; qualitative comparative analysis; Consolidated Framework for Implementation Research

Introduction

Background

Informal caregivers provide essential care and support to individuals with chronic diseases such as cancer and dementia [1,2]. Health care systems rely on informal caregivers to provide a significant portion of the care that individuals with long-term care needs receive [3]. The number of people needed to take on an informal care role is anticipated to increase in the future, as formal care is increasingly shifting to community-based settings [4-6]. Despite the significant societal value of informal care, the informal caregiving role can be a source of burden to informal caregivers [1,2,7,8]. Providing informal care often impacts informal caregivers' mental health, with informal caregivers reporting worse mental health compared with noncaregivers [7,9]. Meta-analyses have estimated the prevalence of depression among dementia and cancer caregivers to be at 31% [10] and 42% [11], respectively. This is substantially higher than that in the general adult population, in which the prevalence of depression has been estimated to be approximately 8% [12,13].

Despite the prevalence of mental health difficulties among informal caregivers, some evidence suggests that few informal caregivers access mental health support [14,15]. Informal caregivers may not seek mental health support because of common access barriers such as stigma and negative views of mental health interventions [16]. However, informal caregivers can experience additional barriers related to the caregiving role, such as competing demands, limited time available for self-care, lack of awareness of available support, and feelings of guilt for seeking support for themselves instead of focusing on the person they are caring for [16-19]. Delivering mental health interventions using internet-based technologies, referred to as e–mental health interventions [20,21], may improve access to mental health support [22,23]. e–Mental health interventions offer flexible access to mental health support by eliminating the need for informal caregivers to spend time traveling to appointments and can often be used according to the informal caregiver's schedule [24].

e–Mental Health Effectiveness and Implementation

e–Mental health interventions can be effective for informal caregivers [25,26]; however, implementation challenges often prevent the integration of e–mental health interventions into practice [27-30]. Implementation challenges span many levels, including factors related to policy (eg, difficulty in navigating regulations), organizations (eg, lack of infrastructure or lack of training), and individual characteristics (eg, negative attitudes and beliefs about e–mental health) [29,31,32]. Evidence suggests that only 3% of evidence-based psychosocial interventions for informal dementia caregivers are translated into practice [30]. Other research suggests that eHealth and e–mental health interventions for dementia caregivers are generally not implementation ready [28].

Currently, the evidence base regarding e–mental health interventions for informal caregivers focuses on intervention effectiveness and efficacy [25,33-38]. Consequently, little is known regarding factors related to the intervention and implementation context that are important to ensure e–mental health interventions for informal caregivers remain effective when implemented. Pragmatic trials may provide more insights into which factors influence intervention effectiveness, given that they are designed to reflect the conditions under which an intervention would be implemented in real-world settings [39]. However, systematic reviews often do not distinguish between evidence derived from pragmatic or explanatory (ie, efficacy) trials [40,41]. Identifying pragmatic trials and examining the conditions under which an intervention was evaluated may provide useful insights into the factors that should be considered when implementing interventions in practice.

Although the literature identifies several barriers to the implementation of e–mental health interventions in real-world settings [28,42-44], few reviews have focused on barriers to and facilitators of implementing eHealth interventions for informal caregivers [27,45-47]. To the best of our knowledge, no review has focused specifically on the implementation of e–mental health interventions for informal caregivers. However, considering contextual factors that may influence intervention effectiveness and implementation is vital for developing interventions optimized for implementation in real-world practice [48]. Implementation is influenced by a variety of

contextual factors that many frameworks seek to define [49,50]. The widely used Consolidated Framework for Implementation Research (CFIR) groups factors that influence implementation within five domains: (1) intervention characteristics (eg, the source of the intervention); (2) the outer setting (eg, external policies and incentives); (3) the inner setting (eg, culture of the implementation setting); (4) individual characteristics (eg, knowledge and beliefs about the intervention); and (5) the implementation process (eg, engaging stakeholders in the implementation process) [51]. Consideration of each domain is important for improving our understanding of key factors that influence the implementation of e–mental health interventions for informal caregivers.

Aims

This review adopted two approaches to examine factors related to the effectiveness and implementation of e–mental health interventions for informal caregivers of adults with chronic diseases: (1) a crisp-set qualitative comparative analysis (QCA) to explore the combinations of intervention and implementation characteristics (eg, provision of support) that are sufficient for intervention effectiveness and (2) a thematic synthesis to identify barriers to and facilitators of the implementation of e–mental health interventions for informal caregivers.

Methods

Overview

The protocol for this mixed methods systematic review has been published [52] and reporting follows guidelines defined by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses; Multimedia Appendix 1) [53] and PRISMA-S (Preferred Reporting Items for Systematic Reviews and Meta-Analyses-literature search extension; Multimedia Appendix 1) [54], the extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. This review was prospectively registered in PROSPERO (International Prospective Register of Systematic Reviews; CRD42020155727). Full details of the methods can be found in the published protocol [52].

Selection Criteria

Selection criteria were defined based on the PICOS (population, intervention, comparators, outcomes, study designs) approach [55,56].

Population

Informal adult caregivers (aged ≥18 years) provide unpaid care to adults with cancer, chronic obstructive pulmonary disease, dementia, diabetes, heart disease, or stroke. These chronic diseases were selected because they are globally responsible for a significant proportion of disability-adjusted life years due to chronic physical diseases [57] and commonly involve informal care [58,59]. Studies were excluded if they exclusively focused on caregivers who were (1) experiencing severe mental health difficulties, (2) caring for individuals who were non–community dwelling, or (3) caring for an individual near the end of life.

Intervention

e–Mental health interventions were defined as those using internet-based technology; for example, web-based platforms or mobile-based apps [21,60]. Interventions designed to target the treatment of common psychological health difficulties (eg, caregiver anxiety, depression, psychological distress, and stress) were included in the review. Any type of mental health treatment, including active or passive psychoeducation [61], was eligible for inclusion. Therapeutic materials had to primarily be delivered using internet-based technology. However, support may have been provided using any delivery mode such as telephone, videoconferencing, or face-to-face contact. Interventions delivering therapeutic materials exclusively using videoconferencing technologies, telephone, or email were excluded.

Comparators

For the QCA, which incorporates intervention effectiveness (eg, effect sizes) into the analysis, randomized controlled trials (RCTs) with nonactive controls [62] (eg, usual care, waitlist control, or information on the health condition of the care recipient) were included. For the thematic synthesis exploring barriers to and facilitators of implementation, studies with any design, regardless of the presence or absence of any control type, were included.

Outcomes

RCTs included in the QCA reported quantitative data on caregivers' mental health, specifically anxiety, depression, psychological distress, and stress. Outcome measures were required to have at least acceptable reliability (Cronbach $\alpha \geq .7$; Multimedia Appendix 2 [51,63-72]). Studies included in the thematic synthesis reported barriers to or facilitators of implementation and included either quantitative (eg, questionnaires) or qualitative (eg, interviews or focus groups) data. Barriers to and facilitators of implementation were defined as any aspect related to the CFIR framework [51] (Multimedia Appendix 2) or the implementation outcomes framework, which classifies implementation outcomes related to acceptability, adoption, feasibility, fidelity, reach, appropriateness, implementation cost, and sustainability [73]. Papers describing the development or initial usability of an intervention were included only if it was clear that the intervention was an e–mental health intervention and all other inclusion criteria were met (eg, the paper reported on factors within the CFIR or implementation outcomes, such as acceptability).

Study Designs

For the QCA, only RCTs were eligible for inclusion. For thematic synthesis, studies with any type of design (eg, case study or process evaluation) were eligible.

Search Strategy

Electronic database searches were conducted in CINAHL Plus with Full Text, the Cochrane Library, Embase, PsycINFO, PubMed, and Web of Science databases. Additional searches were conducted in clinical trial registries [74,75] and OpenGrey [76] to identify relevant trial registries and gray literature (eg, research reports).

The literature search was constructed based on terms related to the following PICOS criteria: (1) informal caregivers (eg, caregiver, caregiver, spouse, and partner); (2) chronic diseases targeted in this review (eg, dementia, Alzheimer disease, cancer, stroke, diabetes, or cardiovascular disease); (3) technology (eg, internet, app, or eHealth); (4) mental health (eg, depression, anxiety, or stress); and (5) therapy (eg, psychoeducation or counseling, intervention). A librarian was consulted when constructing the search strategy, and the search strategy was peer reviewed by 2 researchers with experience conducting reviews in similar fields according to the Peer Review of Electronic Search Strategies peer review guidelines [77]. The full search strategy for PubMed is provided in Multimedia Appendix 2, and the search strategies used for all databases and Peer Review of Electronic Search Strategies peer review feedback can be found in the protocol [52].

Studies published between January 1, 2007, and July 6, 2022, were eligible for inclusion. Studies in languages other than English, Dutch, German, or Swedish were excluded.

Forward and backward citation screening was conducted for all included studies, in addition to screening the first 3 pages of the *similar articles* function in PubMed. Experts in the field (n=16) were also contacted for recommendations of studies to be included in the review.

Study Selection

Database searches were deduplicated using EndNote X9 (Clarivate) [78] and imported into Rayyan [79] to facilitate independent screening of all records by 2 reviewers (CC and EM, GF, or JMZ). Following title and abstract screening, the full texts of all remaining records were checked for eligibility against all elements of the PICOS selection criteria. Conflicts during the screening process were resolved by discussion, and a third reviewer (JW) was consulted as needed. Authors were contacted, at most, twice if more information was needed to determine eligibility. Abstracts, theses, books, commentaries, editorials, and letters-to-the-editor were excluded because of resource limitations. Reviews, trial registries, and protocols were not included; however, (1) references of relevant reviews were screened for studies of interest to the review, (2) published results of relevant trial registries and protocols were sought, and (3) unpublished results from relevant trial registries and protocols were sought from the authors if published results were not yet available. Secondary search strategies (eg, citation screening) were conducted by CC.

Records retrieved from an updated search for papers published between October 2021 and July 2022 (1858 deduplicated records) were screened by only 1 reviewer (CC).

Data Extraction

Data from the included reports related to (1) study characteristics, (2) participant characteristics, (3) intervention characteristics, and (4) study outcomes were extracted using an Excel spreadsheet (version 2016; Microsoft Corporation). The type of support provided by each intervention was classified based on an adapted version of existing support taxonomies [63,64] (Multimedia Appendix 2). Two independent reviewers (CC and EM, GF, or JMZ) extracted quantitative data to evaluate effectiveness and data related to key intervention characteristics. All other data were extracted by 1 reviewer (CC) and confirmed to be accurate and complete by another reviewer (EM, GF, or JMZ). Data extracted from 6 reports found in the updated search were extracted only by 1 reviewer (CC). The original publication was referred to if differences in extractions were identified, followed by a discussion among reviewers, involving a third reviewer (JW), if needed. Reports with data related to implementation were imported into NVivo (version 1.5.1; QSR International) [80].

Risk of Bias

The Cochrane Risk of Bias 2.0 tool [81] was used to assess the quality of all included RCTs. The robvis web-based tool was used to visualize the risk-of-bias assessment [82].

Scoring was performed by 2 independent reviewers (CC and EM or Oscar Blomberg), followed by a discussion to reach consensus. As required, a third reviewer (JW) was involved in the discussion.

Pragmatic Explanatory Continuum Indicator Summary 2 Tool Scoring

RCTs were assessed to determine how pragmatic they were; that is, how well the trial design reflected the real-world setting in which the intervention was likely to be placed. This was evaluated using the Pragmatic Explanatory Continuum Indicator Summary 2 (PRECIS-2) tool [39]. PRECIS-2 evaluated RCTs across 9 criteria. For each criterion, a study receives a score from 1 (very explanatory) to 5 (very pragmatic). Scoring was conducted by 2 independent reviewers (CC and Tasneem Ishrat or JW) followed by discussions to reach a consensus, involving a third reviewer (JW) when needed.

Data Analysis

Overview

A subset of reports included in the review were used for each analytic approach. The QCA included RCTs that evaluated the effectiveness of e–mental health interventions for informal caregivers. The thematic synthesis included reports on factors related to intervention implementation.

Qualitative Comparative Analysis

Overview

A crisp-set QCA [83] was conducted to explore the sets of conditions that were sufficient for interventions to be effective. QCA is well-suited to the study of complex interventions, such as e–mental health interventions, given that multiple solutions (ie, sets of conditions sufficient for intervention effectiveness) can be identified and contextual factors can be incorporated into the analysis [83,84]. A crisp-set QCA involves dichotomizing intervention outcomes and conditions, producing results that can be interpreted more easily by stakeholders [84]. Effectiveness was measured as the standardized mean difference between the mental health outcomes of the control and treatment groups' mental health outcomes, calculated using Hedges g and Comprehensive Meta-Analysis (version 3; Biostat Inc). Hedges g was determined for all mental health outcomes of interest in this review; however, only the RCT's primary mental health

outcome was used in the QCA. If RCTs did not identify a primary outcome, the Hedges g for depression scores, the most frequently reported mental health outcome, was used. Hedges g was calculated using data corresponding to the intention-to-treat or modified intention-to-treat analysis, when possible. Conditions explored in the QCA could be related to intervention (eg, provision of professional support) or implementation (eg, provision of training) characteristics.

Data Table

To complete the data table for the crisp-set QCA, intervention effectiveness and conditions were dichotomized. To dichotomize effect sizes, interventions were classified as effective (Hedges g ≥0.3) or not effective (Hedges g <0.3). The cutoff used to categorize study effectiveness was based on meta-analyses of e–mental health interventions [85-88]. Conditions were classified as being either present or absent.

Truth Table

Truth tables were created to display (1) all potential combinations of conditions used in an analysis, (2) how many interventions had each combination of conditions, and (3) how many interventions with a particular set of conditions were effective. Consistency and coverage scores of 0.75 were used to identify sets of conditions that could be used for Boolean minimization [89,90].

The software fs/QCA (version 3.0; University of California) was used to perform the analysis [91].

Thematic Synthesis

Overview

The thematic synthesis followed approaches adopted by relevant literature on using qualitative analyses to identify barriers to and facilitators of implementation [92,93]. Data related to implementation were primarily deductively coded using the CFIR. However, data that did not fit within the CFIR were inductively coded. Qualitative and quantitative implementation data were integrated by creating narrative summaries of quantitative data (if not described in the original report) and coding the narrative summary to the relevant CFIR constructs [94]. Initially, approximately 10% (n=4) of the reports included in this analysis were independently coded by 2 reviewers (CC and EM). This was followed by a discussion between 3 reviewers (CC, EM, and JW) to arrive at a shared understanding of the CFIR constructs. The remaining reports were coded by 1 reviewer (CC), with a regular discussion of coding decisions with another reviewer (JW or EM).

After initial deductive coding of data to the constructs within the CFIR, inductive coding was used within each construct to identify a preliminary list of implementation barriers and facilitators. The preliminary list of barriers and facilitators, with all supporting statements from included reports, was shared with a second reviewer (EM) for discussion. A revised set of barriers and facilitators was developed based on these discussions. The revised list of barriers and facilitators was reviewed a final time by a third reviewer (JW), leading to a final set of barriers and facilitators.

Professional Stakeholder Involvement

Professionals with expertise in the fields of eHealth and e–mental health (n=4) were consulted for feedback on the results of the thematic synthesis. Professional stakeholders reviewed identified barriers and facilitators and responded to written questions regarding which of the barriers and facilitators they had encountered in practice and what barriers and facilitators they had experienced that were not identified in this review.

Protocol Changes

After beginning the review process, the following modifications were made to the original protocol [52]:

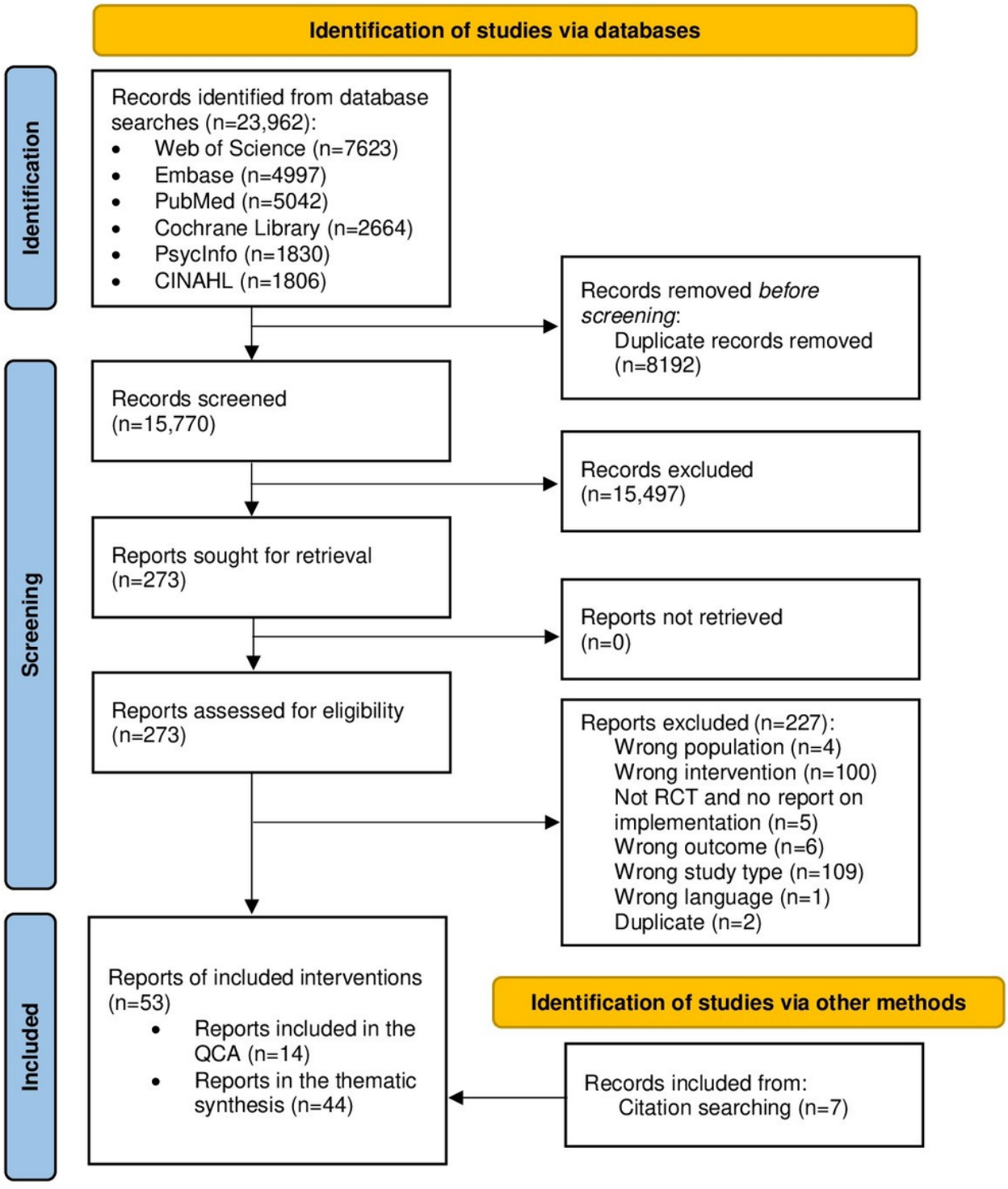
- Originally, we planned to only include pragmatic RCTs, defined as RCTs with a mean score of ≥3 on the PRECIS-2 tool in the QCA. However, RCTs were not excluded on the basis of their PRECIS-2 scores, as planned, because of the low number of RCTs retrieved. Note that all RCTs included in the review met the planned PRECIS-2 cutoff score for inclusion; therefore, this change did not impact the inclusion or exclusion of any reports.
- After deductive coding of data to the CFIR was completed, only 1 reviewer, rather than 2, independently identified barriers and facilitators with each CFIR construct. However, the barriers and facilitators, with supporting statements initially identified by 1 reviewer (CC), were reviewed in detail by a second reviewer (EM) and were regularly discussed and reviewed by JW.
- The results of the thematic synthesis were only presented to professional stakeholders. Informal caregivers were excluded from the review.

Results

Overview

The database searches yielded 23,962 records (Figure 1). After duplicate records were removed (n=8192), titles and abstracts (n=15,770) were screened before full texts (n=273) were retrieved for eligibility screening. Seven included reports were identified using secondary search strategies (eg, backward and forward citation searching). In total, 53 reports (representing 29 interventions) were included in the review (see Multimedia Appendix 3 for a list of excluded studies). The QCA included 14 reports of RCTs, and the thematic synthesis included 44 reports. Five reports were included in both the QCA and thematic synthesis.

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart of the study identification process. QCA: qualitative comparative analysis; RCT: randomized controlled trial.



Descriptive Characteristics

RCT Characteristics

The characteristics of the 14 reports of RCTs (14 interventions) are presented in Table 1. The RCTs included between 31 and 638 participants, with an overall attrition rate between 11% and 67%. Five RCTs included a follow-up observation point beyond the postintervention follow-up time point [65,95-98], and no RCT included a follow-up beyond 6 months after the intervention was completed. Depression was the most commonly measured mental health outcome (n=12), followed by anxiety (n=8), stress (n=6), and distress (n=1). General mental health was measured in 2 RCTs.

Table 1. Descriptive characteristics of randomized controlled trials (n=14).

Caregiver characteristics	Care recipient health condition	Type of control	Follow-up time points, and study attrition rates
Baruah et al [99], 2021; India			
• N=151 (I[a]: 74, C[b]: 77) • Mean age (years)—I: 46.5 (SD 14.1), C: 42.2 (SD 11.9) • Female I: 46% (34/74), C: 47% (36/77) • Spouse I: 20% (15/74), C: 21% (16/77) • Mean baseline mental health score (CES-D[c] 10)—I: 10.3 (SD 5.1), C: 11.1 (SD 5.1)	Dementia	Information	• Postintervention follow-up: I+C: 64% (96/151), I: 61% (45/74), C: 66% (51/77)
Blom et al [100], 2015; Netherlands			
• N=251 (I: 151; C: 100) • Mean age (years)—I: 61.5 (SD 11.9), C: 60.8 (SD 13.1) • Female—I: 70% (104/149), C: 69% (66/96) • Spouse—I: 60% (89/149), C: 56% (54/96) • Mean baseline mental health score (CES-D 20)—I: 17.9 (SD 9.1), C: 16.6 (SD 9.7)	Dementia	Information	• Postintervention follow-up: I+C: 30% (76/251), I: 40% (61/151), C: 15% (15/100)
Bodschwinna et al [98], 2022; Germany			
• N=60 (I: 30, C: 30) • Mean age (years): I: 47.7 (SD 8.9), C: 47.7 (SD 10.5) • Female—I: 68% (23/30), C: 62% (18/29) • Spouse—I: 100% (30/30), C: 100% (29/29) • Mean baseline mental health score (PHQ-8[d]): I: 8.9 (SD 4.8), C: 8.2 (SD 4.5)	Cancer	WLC[e]	• Postintervention follow-up: I+C: 18% (11/60), I: 27% (8/30), C: 10% (3/30) • 2-month follow-up: I+C: 30% (18/60), I: 33% (10/30), C: 27% (8/30)
Boots et al [101], 2018; Netherlands			
• N=81 (I: 41, C: 40) • Mean age (years): I: 67.8 (SD 10.2) C: 70.2 (SD 10.1) • Female—I: 71% (29/41), C: 60% (24/40) • Spouse—I: 90% (37/41), C: 93% (37/40) • Mean baseline mental health score (CES-D 20)—I: 13.1 (SD 8.7), C: 13.1 (SD 9.0)	Dementia	WLC	• Postintervention follow-up: I+C: 16% (13/81), I: 24% (10/41), C: 8% (3/40)
Christancho-Lacroix et al [95], 2015; France			
• N=49 (I: 25, C: 24) • Mean age (years)—I: 64.2 (SD 10.3), C: 59.0 (SD 12.4) • Female—I: 64% (16/25), C: 67% (16/24) • Child—I: 64% (16/25), C: 54% (13/24) • Mean baseline mental health score (PSS[f]-14)—I: 24.2 (SD 9.0), C: 24.5 (SD 6.7)	Alzheimer disease	TAU[g]	• Postintervention follow-up: I+C: 18% (9/49), I: 20% (5/25), C: 17% (4/24) • 3-month follow-up: I+C: 31% (15/49), I: 32% (8/25), C: 29% (7/24)
DuBenske et al [65], 2014; United States			

Caregiver characteristics	Care recipient health condition	Type of control	Follow-up time points, and study attrition rates
• N=285[h] (I: 144, C: 141) • Mean age (years)—I: 56.6 (SD 12.9), C: 54.6 (SD 12.2) • Female—I: 66% (82/124), C: 70% (86/122) • Spouse—I: 73% (91/124), C: 70% (86/122) • Mean baseline mental health score (negative mood[i])—I: 0.88 (SD 0.77), C: 1.1 (SD 0.88)	Lung cancer	TAU and information	• Postintervention follow-up[j]: I+C: 40% (115/285), I: 41% (59/144), C: 40% (56/141) • 2-month follow-up[k]: I+C: 49% (139/285), I: 48% (69/144), C: 50% (70/141)
Fossey et al [102], 2021; United Kingdom			
• N=638 (intervention 1[l]: 213, intervention 2[l]: 213, C: 212) • Mean age (years)—intervention 1[l]: 60.2 (SD 12.1), intervention 2[l]: 60.2 (SD 12.6), C: 59.2 (SD 12.0) • Female—intervention 1[l]: 85% (182/213), intervention 2[l]: 85% (182/213), C: 85% (181/212) • Spouse—intervention 1[l]: 43% (91/213), intervention 2[l]: 48% (102/213), C: 40% (85/212) • Mean baseline mental health score (GHQ-12[m]): intervention 1[l]: 16.3 (SD 4.1), intervention 2[l]: 16.3 (SD 4.1), C: 16.5 (SD 3.9)	Dementia	Attention	• Postintervention follow-up: intervention 1[l]+intervention 2[l]+C: 67% (430/638), intervention 1[l]: 75% (160/213), intervention 2[l]: 53% (112/213), C: 75% (158/212)
Gustafson et al [103], 2019; United States			
• N=31 (I: 16, C: 15) • Age (years): 55-64 (I: 3/16, 19%, C: 3/15, 20%); 65-74 (I: 7/16, 44%, C: 9/15, 60); ≥75 (I: 6/16, 38%, C: 3/15, 20%) • Female—I: 69% (11/16), C: 53% (13/15) • Spouse—I: 94% (15/16), C: 87% (13/15) • Mean baseline mental health score (PHQ-8): I: 4.1 (SD 3.5), C: 4.4 (SD 4.3)	Dementia	Information	• Postintervention follow-up: I+C: 16% (5/31), I: 13% (2/16), C: 20% (3/15)
Hepburn et al [96], 2022; United States			
• N=261 (I: 96, control 1[n]: 111, control 2[n]: 54) • Mean age (years): I: 66.0 (SD 10.9), control 1[n]: 63.8 (SD 11.6), control 2[n]: 63.7 (SD 10.7) • Female: I: 75% (72/96), control 1[n]: 66% (73/111), control 2[n]: 72% (39/54) • Spouse: I: 72% (69/96), control 1[n]: 61% (68/111), control 2[n]: 65% (35/54) • Mean baseline mental health score (CES-D-20): I: 13.1 (SD 10.0), control 1[n]: 12.1 (SD 10.1), control 2[n]: 11.1 (SD 8.3)	Dementia	Attention; WLC	• 1-month follow-up[o]: I+control 1[n]+control 2[n]: 25% (64/261), I: 26% (25/96), control 1[n]: 25% (28/111), control 2[n]: 20% (11/54) • 4-month follow-up[o]: I+control 1[n]+control 2[n]: 23% (61/261), I: 24% (23/96), control 1[n]: 27% (30/111), control 2[n]: 15% (8/54)
Kajiyama et al [104], 2013 United States			

Caregiver characteristics	Care recipient health condition	Type of control	Follow-up time points, and study attrition rates
• N=150 (I: 75, C: 75) • Mean age (years): I: 55.2 (SD 11.3), C: 57.0 (SD 12.5) • Female—I: 83% (38/46), C: 86% (49/57) • Spouse—I: 56% (26/46), C: 51% (29/57) • Mean baseline mental health score (PSS-10)—I: 18.5 (SD 5.2), C: 16.2 (SD 6.9)	Dementia	Information	• Postintervention follow-up: I+C: 31% (47/150), I: 39% (29/75), C: 24% (18/75)
Köhle et al [105], 2021; Netherlands			
• N=203 (intervention 1[p]: 67, intervention 2[p]: 70, C: 66) • Mean age (years): intervention 1[p]: 57.0 (SD 9.9), intervention 2[p]: 56.4 (SD 11.2), C: 54.2 (SD 11.0) • Female: intervention 1[p]: 70% (47/67), intervention 2[p]: 71% (50/70), C: 70% (46/66) • Spouse—intervention 1[p]: 100% (67/67), intervention 2[p]: 100% (70/70), C: 100% (66/66) • Main baseline mental health score (HADS[q]): intervention 1[p]: 12.5 (SD 0.7), intervention 2[p]: 12.4 (SD 0.7), C: 12.7 (SD 0.7)	Cancer	WLC	• Postintervention follow-up: intervention 1[p]+intervention 2[p]+C: 32% (64/203), intervention 1[p]: 28% (19/67), intervention 2[p]: 44% (31/70), C: 21% (14/66)
Kubo et al [106], 2019; United States			
• N=31 (I: 17, C: 14) • Mean age (years)—I: 57.1 (SD 17.4), C: 58.2 (SD 18.6) • Female—I: 53% (9/17), C: 64% (9/14) • Spouse—I: 47% (8/17), C: 79% (11/14) • Mean baseline mental health score (HADS-D[r])—I: 5.1 (SD 3.4), C: 5.6 (SD 2.9)	Cancer	WLC	• Postintervention follow-up: I+C: 16% (5/31), I: 24% (4/17), C: 7% (1/14)
Pensak et al [107], 2021; United States			
• N=72 (I: 36, C: 36) • Mean age (years)—I: 53.3 (SD 14.7), C: 55.1 (SD 10.9) • Female: I: 73% (19/26), C: 77% (23/30) • Spouse—I: 77% (20/26), C: 83% (25/30) • Main baseline mental health score (HADS-A[s])—I: 11.2 (SD 2.5), C: 11.6 (SD 3.0)	Cancer	TAU	• Postintervention follow-up: I+C: 11% (8/72), I: 14% (5/36), C: 8% (3/36)
Smith et al [97], 2012; United States			

Caregiver characteristics	Care recipient health condition	Type of control	Follow-up time points, and study attrition rates
• N=37[t] (I: 18[t], C: 19) • Mean age (years)—I: 55.3 (SD 6.9), C: 54.9 (SD 12.9) • Female—I: 100% (18/18), C: 100% (19/19) • Spouse—I: 100% (18/18), C: 100% (19/19) • Mean baseline mental health score (CES-D 20)—I: 21.7 (SD 13.2), C: 17.7 (SD 11.7)	Stroke	Information	• Postintervention follow-up: I+C: 14%[t] (5/37), I: 17%[t] (3/18), C: 11% (2/19) • 1 month follow-up: I+C: 14%[t] (5/37), I: 17%[t] (3/18), C: 11% (2/19)

[a]I: intervention arm.

[b]C: control arm.

[c]CES-D: Center for Epidemiological Studies–Depression scale.

[d]PHQ-8: Patient Health Questionnaire depression scale 8 items.

[e]WLC: waitlist control.

[f]PSS: Perceived Stress Scale.

[g]TAU: treatment as usual.

[h]Adjusted to exclude a dropped treatment arm.

[i]Negative mood was based on a modified version of the Short Version Profile of Mood States.

[j]Postintervention was defined as the primary end point measurement specified within the study (6 months).

[k]Caregivers were followed bimonthly for up to 24 months; however, only measurements up to 8 months of follow-up (2 months after the intervention) were analyzed.

[l]In Fossey et al [102], intervention 1 represents the standard intervention and intervention 2 represents intervention with telephone support.

[m]GHQ-12: General Health Questionnaire–12 items.

[n]In Hepburn et al [96], control 1 represents attention control and control 2 represents WLC.

[o]In Hepburn et al [96], 1-month follow-up is referred to as a 3-month follow-up from baseline in the original paper; 4-month follow-up is referred to as a 6-month follow-up from baseline in the original paper.

[p]In Köhle et al [105], intervention 1 represents an intervention with personalized support and intervention 2 represents an intervention with automated support.

[q]HADS: Hospital Anxiety and Depression Scale.

[r]HADS-D: Hospital Anxiety and Depression Scale–Depression subscale.

[s]HADS-A: Hospital Anxiety and Depression Scale–Anxiety subscale.

[t]Adjusted to exclude 1 participant found ineligible after randomization.

Intervention Characteristics

The characteristics of the included interventions (n=29) are summarized in Multimedia Appendix 4 [65,95-147]. The interventions were investigated in the United States (n=16) [65,96,97,103,104,106-125], Europe (n=10) [95,98,100-102,105,126-141], Australia (n=2) [142,143], and India (n=1) [99,144,145]. Most interventions were designed for informal caregivers of people with dementia (n=16) [95,96,99-104,112-117,126-134,136,141,143-147] and cancer (n=11) [65,98,105-111,119-125,135,137-140,142], with 2 interventions focused on informal caregivers of stroke survivors [97,118]. Interventions were commonly based on cognitive behavioral therapy (n=10) [98-100,102,104,107,115,124,125,134,135,137,141-144], stress and coping theory (n=9) [65,95-97,101,103,109,110,113,114,121-123,126-133], mindfulness (n=7) [106,108,111,116-120], or acceptance and commitment therapy (ACT; n=3) [105,112,136,138-140,146]. Most interventions included support (n=22), providing standardized (n=9) [99,105-108,111,116-118,124,125,138-140,142,144], guided (n=7) [96,97,101,102,113,114,119,126-132,134], or minimal (n=5) [98,100,105,135-141,146] support. A novel support type identified was tailored standardized support that involved automated messages tailored based on information provided by participants while using the intervention (n=2) [65,109,110,122]. Six interventions were fully self-administered [95,103,104,112,115,120,133].

Qualitative Comparative Analysis

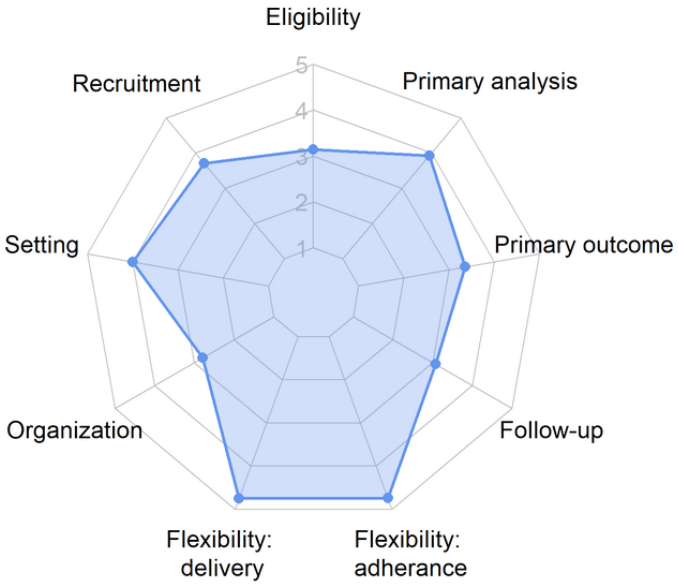
In total, 14 reports of RCTs were included in the crisp-set QCA. On the basis of the Hedges g and the cutoff set to classify interventions as effective or not effective, 5 RCTs were classified as effective (Multimedia Appendix 4). The conditions (intervention and implementation characteristics) explored in the QCA included the presence of peer support, professional support, and a selection of persuasive design elements [148] (reminders and tunneling, ie, controlled module order). None of the explored combinations of 2 or 3 conditions resulted in a consistency and coverage above 0.75 (Multimedia Appendix 4); therefore, the analysis could not proceed.

PRECIS-2 Scores

The 14 RCTs included in the study were scored according to the PRECIS-2 tool to examine how pragmatic each trial was. All RCTs had an average PRECIS-2 score of at least 3, meaning

each had at least a mixture of more pragmatic and more explanatory design choices. Domains of the PRECIS-2 tool, which were the most pragmatic across all RCTs, were flexibility of intervention delivery and flexibility of measures taken to monitor and increase adherence (Figure 2). The most explanatory domains were the eligibility of participants, organization of the intervention, and follow-up procedures (Figure 2). PRECIS-2 scoring for individual RCTs can be found in Multimedia Appendix 4.

Figure 2. Mean Pragmatic Explanatory Continuum Indicator Summary 2 (PRECIS-2) scores from included randomized controlled trials (n=14). Trials were scored between 1 (very explanatory) and 5 (very pragmatic) for each domain of PRECIS-2.



Risk of Bias

As assessed using the Cochrane Risk of Bias 2.0 tool [149], 13 RCTs were found to have an overall high risk of bias [65,95-97,99,101-107], with 1 RCT [100] being rated as having some concerns (Multimedia Appendix 4). Domain 4, which assesses bias in the measurement of the outcome, was the domain that largely contributed to the overall high risk of bias in most reports. Bias related to the randomization process (domain 1) and deviation from the intended intervention (domain 2) was most frequently scored as having a low risk of bias.

Thematic Synthesis

In total, 44 reports (representing 27 interventions) were included in the thematic synthesis (Table 2). The most frequently reported domains were *innovation characteristics* and *individual characteristics*. Barriers to and facilitators of the implementation of e–mental health interventions for informal caregivers are reported in Multimedia Appendix 5 [95,98,104,105,108-147] with relevant example quotations. Within the thematic synthesis, barriers and facilitators were attributed to stakeholders and informal caregivers. The term *stakeholder* is used to describe any professional group, for example, health care professionals and staff, involved in implementation.

Table 2. Summary of identified barriers and facilitators.

CFIR[a] construct	Reports that identified barriers	Reports that identified facilitators
Domain 1: innovation characteristics		
Innovation source	No data	[129,130]
Evidence strength and quality	[128-130]	[114,125,128-130]
Relative advantage	[95,114,121,123,126,128,140,142,146]	[114,117,120,126,127,130,132,136,139,142]
Adaptability	[109,126,127,136,138]	[108,113,120,125-127,131,132,134,136,138-140]
Trialability	No data	[130]
Complexity	[113,114,117,125-128,132,133]	No data
Design quality and packaging	[95,98,108,110,111,114,117-120, 123-140,142-146]	[95,98,104,105,108-111,113-117,119, 120,123-128,130-146]
Costs	[128,129,147]	[130,143]
Domain 2: outer setting		
Needs and resources of those served by the organization	[128,129]	[128,130]
Cosmopolitanism	[129]	[128-130,143]
Peer pressure	No data	[129]
External policy and incentives	No data	[128,130]
Domain 3: inner setting		
Structural characteristics	No data	No data
Networks and communications	[128,130]	[128]
Culture	No data	No data
Implementation climate	No data	[144]
Tension for change	No data	No data
Compatibility	[122,123,127,128,130]	[122,127-129,143,146]
Relative priority	[127,128]	No data
Organizational incentives and rewards	[128]	No data
Goals and feedback	[128]	[128]
Learning climate	No data	[146]
Readiness for implementation	[127,129]	No data
Leadership engagement	[127-129]	No data
Available resources	[127-129]	No data
Access to knowledge and information	[122,123,127,146]	[146]
Domain 4: individual characteristics		
Knowledge and beliefs about the innovation	[95,98,113,114,117,120-123,126-130, 133,138-140,142,146]	[95,98,105,108,109,112-120, 123-133,135-140,143,145,146]
Self-efficacy	No data	[128,129,146]
Individual stage of change	[95,121,124,125,127,138-140]	No data
Individual identification with organization	No data	[114,127,140]
Other personal attributes	[95,98,108,110,113-115,119,121, 125-129,131,133,135,138-144]	[114,127,129-131,139,140,143,144]
Domain 5: process		
Planning	[128,129]	[127,130]
Engaging	[128]	[120,128,129,144]
Opinion leaders	No data	No data

CFIR[a] construct	Reports that identified barriers	Reports that identified facilitators
Formally appointed internal implementation leaders	[128]	No data
Champions	[129]	No data
External change agents	No data	[128,129]
Key stakeholders	[128,129]	[127,129,143]
Innovation participants	[128,129,138,144]	[115,129,143,144]
Executing	No data	No data
Reflecting and evaluative	No data	No data

[a]CFIR: Consolidated Framework for Implementation Research.

Domain 1: Innovation Characteristics

Facilitators

Interventions that were developed at a trusted source (eg, academic institutions) [129] and originated as a research project [130] were viewed positively by those involved in implementation. Stakeholders and informal caregivers (hereafter referred to as caregivers) valued interventions based on pragmatic evidence [125,130]. However, caregivers also valued the incorporation of knowledge from those with lived experience (eg, other caregivers) as another form of evidence [114].

Interventions tended to be well-designed and easy to use [98,105,108-110,113,116,117,124-127,131-134,136-138,141,143,146]. There were mixed views on whether caregivers preferred dyadic or individual interventions [109,110,125,135,139,140]; however, there was generally a need for space to be created to allow caregivers to express themselves without the presence of care recipients [119,123]. The internet-based nature of interventions was generally well-accepted and offered some advantages over face-to-face interventions [114,117,120,126,127,130,136,139,142], including (1) no need to travel [114,126] and (2) material being available all the time [127]. Interventions using different forms of media to deliver content [120,127,138,144] and supporting the use of interventions across devices (eg, ability to use intervention on a smartphone and computer) [132,144] made it easier for caregivers to use interventions. Tailored intervention content (eg, tailored to the care recipient's stage of disease) [126,131,138,140,143,144], the provision of professional support [114,119,126,127,131-133,135,136,138-141,143,144], a positive tone for information that was presented [125,127,138,140], and contact with information from other caregivers [114,120,126,127,131,132,136,138-140,143,144] were important features to ensure interventions were relevant and met the needs of caregivers.

Interestingly, although caregivers expressed a preference for flexible use options, such as accessing modules on demand based on their needs [108,113,120,125-127,131,132,134,136,138-140], stakeholders suggested a need to control module access to guide caregivers through the intervention and avoid confusion [127]. Stakeholders also valued interventions with features that supported user tracking to facilitate monitoring and evaluation of the implementation of the intervention [128] (also see inner setting: goals and feedback in Multimedia Appendix 5).

Barriers

Evidence suggesting interventions remained effective when implemented in real-world settings [128], and information on outcomes more relevant to health care organizations (eg, number of caregivers receiving support) [129,130] was lacking. Although e–mental health interventions have advantages, both caregivers and stakeholders expressed that communication within e–mental health interventions could be challenging [123,126,128,146]. Unfamiliar technologies and multistep intervention and implementation activities (eg, recruitment of intervention staff) added complexity to e–mental health interventions [113,128]. Stakeholders felt that the economic costs related to e–mental health interventions were unclear [129] and that interventions would not be cost-effective [128,147].

Interventions with content not appropriately tailored to the intervention user [95,114,124,126,127,131,132,135,136,140,142,144] or that did not capture the diversity of caregivers' backgrounds and care situations [114,124] made it challenging for caregivers to identify with the content. There was also a need for interventions to be linguistically and culturally tailored to meet the needs of different user groups within an implementation setting [143,144]. Interventions often did not meet all caregivers' needs for support and information [95,98,110,114,117,120,123-127,130,133,135,136,138-140,143,144]. In addition, technical difficulties [98,108,114,118,124,126,129,130,144] and limited viewing options [118,123-127,134,137,138,144], in particular, the lack of downloadable material so that the intervention could be used without active internet access, were important barriers to caregivers using the intervention more flexibly.

Domain 2: Outer Setting

Facilitators

Generally, stakeholders perceived intervention content to fit caregivers' needs [128,130]. Stakeholders also stressed the need for support from cooperating organizations to facilitate implementation activities, with these activities potentially strengthening the relationship between partner organizations [128-130,143]. Additional facilitators included peer pressure due to digitalization in other sectors [129] and the fit between intervention and external policies (eg, informal care policies) [128,130].

Barriers

Stakeholders reported low interest in eHealth technologies among community members within their setting [129] and felt unsure what support services caregivers needed [128,129]. As mentioned, relationships with cooperating organizations were important to facilitate implementation [128-130,143]; however, partner organizations may not have the time available to support implementation [129].

Domain 3: Inner Setting

Overview

Barriers and facilitators within this domain were primarily derived from a series of reports investigating 2 interventions: (1) Partner in Balance, an intervention for informal caregivers of people with dementia [101,126-130] and (2) the Comprehensive Health Enhancement Support System (CHESS) intervention for caregivers of people with lung cancer, which contains a clinician report feature linking the caregiver-care recipient dyad to the care recipient's health care provider [65,121-123].

Facilitators

Open and accessible communication channels within the implementation team facilitated intervention implementation [128]. Stakeholders viewed the ability to monitor intervention use as important to facilitate reporting on concrete intervention outputs [128]. The lack of support available for caregivers created an environment that was receptive to an intervention for caregivers [144]. Implementation was supported by the provision of training and support to stakeholders involved in intervention delivery [146]. Key facilitators related to the compatibility of the intervention within the implementation setting included (1) the integration of the intervention within existing workflows [127,128,143,146], (2) flexible use options for providers [122,127], and (3) alignment between the intervention and the organizations' existing goals and priorities [128,129].

Barriers

Many barriers were not described in detail; however, a lack of internal support networks (eg, implementation teams) to support implementation [128,130], incentives [128], goal setting [128], leadership engagement [127-129], and resources (eg, staff time) [127-129] have been reported. Uncertainties due to upcoming organizational change and restructuring have made it difficult for some organizations to adopt a new intervention [127,129]. Barriers regarding compatibility were raised including the challenge of providing an intervention to caregivers within a system oriented toward patients [127,130], poor integration of the intervention within existing systems and processes [122,123], perceived low digital literacy among implementers [128], and a mismatch between the organizations' clientele and the intervention target population [127,128]. In relation to the clinician report within the CHESS intervention adapted for lung cancer caregivers, unclear clinical guidance regarding how to use information provided within the intervention made it challenging for health care professionals to use the intervention [122,123].

Domain 4: Individual Characteristics

Facilitators

Interventions were identified as benefiting caregivers in many ways (eg, providing information or supporting self-care) [95,98,105,108,109,112,113,115-120,124-127,129-132,136-139,146], with some interventions also facilitating a sense of connection with other caregivers [113,114,120,136,140,143] and reducing feelings of isolation [113,114,124,127,131,133,136,143]. Interventions normalized and validated caregivers' lived experiences by depicting scenarios that intervention users had personally experienced [114,124,125,127,131,132,135,136,138,140,145]. Interventions, including support from a trained professional, were perceived as also benefiting the trained professional and had a positive impact on the relationship between the trained professional and caregiver [123,127-129,131,146]. Provision of support was viewed as an important source of motivation for caregivers to use the intervention [98,127,132,138,140]. It was perceived that interventions would be best suited for caregivers who were young [114,127,129,130,139], employed [127], experiencing difficulties (eg, burden) [139,140], or not receiving adequate support from their social network [140]. Stakeholders held positive views of e–mental health [98,129], perceiving interventions as time efficient [128,146] and as a way to improve access to support [131,146], including improving support for caregivers in rural communities [143].

Barriers

Both caregivers and stakeholders reported concerns related to e–mental health interventions, including privacy and liability concerns [98,120-123,128], feeling that web-based interventions are impersonal [95,113,114,126,138,139,142], and concerns that the intervention could have a negative impact (eg, increase isolation) [98,120,126,127,133] or be emotionally challenging [95,117,126,127,138-140] for caregivers. Stakeholders had little experience with eHealth technologies, making implementation challenging [129]. In addition, some stakeholders found it challenging to create a therapeutic relationship within the e–mental health intervention [146]. For some caregivers, the intervention had come at the wrong time (eg, the information was no longer relevant or they had already moved past certain challenges) [95,121,124,125,127,138,140], whereas others were not ready to accept help [121,140] or face difficult emotions that an intervention may prompt [95,127,139]. Caregivers also reported individual challenges engaging with e–mental health interventions such as having too many other responsibilities [108,110,113-115,125,127,131,135,138,139,142-144], feelings of shame stopping them from sharing their experiences [119,127,138], and care recipient related challenges (eg, not wanting their care recipient to know they are receiving the intervention) [98,126,127,140]. Some caregivers were not in need of an e–mental health intervention [95,121,135,138-140,142] and had their support needs met in other ways [138-141]. Low digital literacy, and lack of access to internet or computers among caregivers were also challenges for caregivers using e–mental health interventions [95,114,121,126-129,133,140,142-144]. In contrast, 1 study

[144] reported that caregivers' skills and familiarity with using the internet could facilitate implementation.

Domain 5: Process

Facilitators

Financial planning [127,130] and a sense of ownership toward the intervention [128,129] were perceived as facilitators of implementation. Engaging external organizations to assist with intervention implementation [128,129] and training and retention of key staff members who deliver the intervention [127,129] were important elements of the implementation process. Strategies to reach a diverse group of caregivers from different backgrounds were perceived as valuable by both caregivers and stakeholders [115,129]. Engagement strategies included the engagement of caregivers and stakeholders in early decision-making stages [129,143], seeking feedback from caregivers about the intervention [144], engaging the entire informal care network (eg, rather than focusing on primary caregivers) as potential users of the intervention [143], and speaking with caregivers face-to-face to build a connection with caregivers and integrate intervention referral into any interaction professionals have with caregivers [129,143].

Barriers

Inadequate implementation planning [128,129], low engagement of organization leaders [128], intervention champions [129], intervention providers [128,129], and informal caregivers [128,129,144] were barriers to implementation. Both caregivers and stakeholders felt face-to-face strategies to engage caregivers in the intervention (eg, during recruitment or at the start of the intervention) were needed [138]. In 1 study [128], training provided to intervention providers lacked focus on the practical skills needed to implement and deliver the intervention.

Professional Stakeholder Involvement

Overview

Professional stakeholders (n=4) with experience working in the field of eHealth and e–mental health recognized many barriers and facilitators identified in the thematic synthesis. For example, stakeholders had encountered facilitators such as (1) e–mental health and eHealth interventions being easy to use, (2) the ability of interventions to easily facilitate data collection, and (3) national policy changes enabling flexible implementation of e–mental health interventions throughout a country. Stakeholders also recognized several barriers to implementation identified in the thematic synthesis, such as (1) negative views about e–mental health, (2) technical difficulties, and (3) lack of organizational incentives to implement e–mental health interventions.

However, stakeholders also identified additional implementation barriers and facilitators they have experienced and areas they felt that future research should focus on.

Facilitators

Intervention characteristics, including (1) the ability to adapt interventions to expand their use among different populations and (2) low complexity for stakeholders to provide interventions, were facilitating factors when implementing e–mental health interventions in practice. Within the inner setting, the provision of training materials was a facilitator. e–Mental health interventions were also perceived to add variety to work routines of staff involved in intervention delivery. Engagement of formally appointed implementation leaders, endorsement of the intervention by influencers or celebrities, and a positive web-based presence (eg, reviews and social media presence) were valuable to facilitate implementation.

Barriers

Key factors related to the inner setting were referred to as additional barriers, including (1) changes to work routines that negatively impact how well the intervention fits within the implementation setting; (2) changing the priority of the intervention as it competes with other interventions and initiatives for resources; (3) challenging implementation climate due to staff being overwhelmed by numerous new digital tools; and (4) poor fit between the intervention and internal policies and regulations. Barriers related to negative knowledge and beliefs regarding e–mental health interventions were identified within the thematic synthesis; however, one negative belief not reported in the literature was the perception that e–mental health interventions are a cheaper but not more effective alternative to face-to-face interventions. Linked to this was the importance of recognizing that e–mental health interventions should be offered as a choice to users, rather than the sole treatment option available. The lack of realistic implementation planning and knowledge about the amount of resources needed to implement an e–mental health intervention was also a challenge. Lack of evidence and knowledge about implementation strategies that effectively enhance the implementation of e–mental health interventions was also viewed as a barrier to implementation.

Areas for Future Research

Professional stakeholders identified the following areas for future research: (1) how to best combine e–mental health interventions with other interventions (both eHealth and face-to-face interventions); (2) defining core elements needed for e–mental health interventions to maintain effectiveness; (3) methods to maximize the engagement and retention of e–mental health users; (4) how to influence individuals' views of e–mental health; and (5) further research on the benefits of eHealth for both users and stakeholders (eg, how they impact quality of care).

Discussion

Principal Findings

Overview

This mixed methods systematic review identified 53 reports that investigated the effectiveness or implementation of e–mental health interventions for informal caregivers of adults with chronic diseases. Interventions were most often tailored for informal caregivers of people with dementia or cancer, with few interventions focused on informal caregivers of people with other chronic conditions included in this review (chronic obstructive pulmonary disease, diabetes, heart disease, and stroke). Interventions were commonly theory based and varied in terms of the type of support provided to intervention users.

A unique type of support identified in this review was tailored standardized support, which provides intervention users with standardized support messages, but tailors messages based on information provided by an individual user.

Overall, 14 RCTs were included in the review. RCTs contained a mixture of pragmatic and explanatory design features, as assessed using the PRECIS-2 tool, and most were evaluated as having a high risk of bias (discussed further in the *Limitations* section). The PRECIS-2 scoring showed that the domains of intervention delivery and adherence were very pragmatic, with no measures to ensure adherence to the intervention beyond what would be expected outside a trial environment. The trial setting was often pragmatic because most trials allowed participants to be located in a variety of geographic areas and did not focus on a single recruitment site. Trials commonly used a variety of recruitment methods (eg, via health care and community settings), which was viewed as a pragmatic design choice, given that informal caregivers would ideally be able to find out about available support services through a variety of pathways. Despite PRECIS-2 scores demonstrating that all RCTs contained some pragmatic design features, RCTs were frequently conducted within academic settings without indications as to how the interventions could be integrated into routine practice.

The QCA could not be fully conducted because of low consistency in which conditions were sufficient for intervention effectiveness. In cases where consistency was high enough to proceed with the analysis, solution coverage (ie, coverage of the set of conditions with a consistency of at least 0.75) was low, as the solutions were based on only 1 to 2 RCTs. The challenges encountered in the QCA analysis were mainly due to the low number of RCTs (n=14) included in the analysis. In addition, poor reporting of key intervention features posed a challenge to including implementation-related conditions in the QCA analysis.

Poor reporting of key intervention features and intervention targets presented a challenge in determining whether interventions were designed to target informal caregivers' mental health. For example, in one case, the intervention target differed across cultural adaptations of the intervention [99,150,151]; however, the rationale as to why intervention targets differed and whether this impacted the intervention content was unclear. Poor intervention reporting is a common problem in the wider literature, despite the development of reporting guidelines such as CONSORT (Consolidated Standards of Reporting Trials) [152] and Template for Intervention Description and Replication (TIDieR) [153]. In 1 review of reviews [154], it was found that almost 88% of the included studies had below-optimal levels of reporting in accordance with CONSORT. Another review of reviews [155] showed variation in reporting quality based on each item of the TIDieR. Incomplete reporting based on the TIDieR was most often observed regarding (1) intervention modifications, (2) planned and actual intervention adherence and fidelity, (3) tailoring, (4) descriptions of the intervention provider, and (5) where the intervention occurred [155]. Poor reporting in some of these areas was observed in this review. For example, a description of the training provided to intervention providers was often vague or absent, and fidelity and adherence to the intervention among intervention providers and users was underreported. A similar finding was reported in a study using the ImpRess checklist to assess the implementation readiness of 12 eHealth interventions for informal dementia caregivers [28]. Poor intervention reporting may pose a challenge to future implementation given that the details needed to implement and deliver interventions are lacking.

Implementation Barriers and Facilitators

Most identified barriers and facilitators were related to the intervention or individual characteristic domains within the CFIR. Implementation determinants related to the inner and outer setting and the implementation process were rarely reported. The lack of information on implementation barriers and facilitators related to the implementation setting can be partly related to the nature of the included reports, which commonly focused on intervention acceptability during the development or adaptation of an intervention. Although implementation determinants were reported in development studies, these determinants represent anticipated barriers and facilitators, rather than actual barriers and facilitators encountered during implementation. Intervention implementation outside of a research setting was rarely explored. Other reviews focused on the implementation of eHealth interventions for different groups of informal caregivers [27,46,47] similarly found that there was a lack of reporting of implementation determinants related to the inner and outer setting.

Overall, the literature indicates that intervention development is done well, with the views of informal caregivers and stakeholders being included in the development process in a variety of ways (eg, surveys, focus groups, and usability testing). This aligns with the current Medical Research Council framework for developing and evaluating complex interventions, which places the engagement of all stakeholders (including intervention users) as a core element that should be included in each phase of intervention development and evaluation [48]. Although intervention development did engage stakeholders, data collection rarely explored implementation barriers and facilitators with stakeholders beyond intervention acceptability. As such, many aspects of another core element of the current Medical Research Council framework, that is, context, remain largely unexplored [48].

Recruitment of informal caregivers in intervention research is well-established as challenging [121,156-158], and this challenge can persist after interventions are implemented. Within the CFIR, recruitment of intervention users falls within the construct *engaging* under domain 5: process. Recruitment strategies, such as face-to-face contact, were identified as potential facilitators of the implementation of e–mental health interventions. However, the effectiveness of strategies to recruit and sustain intervention engagement was not explored. Strategies to recruit informal caregivers and improve awareness of available e–mental health interventions require further research, and critical examination of whether e–mental health interventions are being accessed by informal caregivers experiencing mental health difficulties should be explored in future studies.

Several barriers to and facilitators of implementation indicated the importance of tailoring intervention content, visuals, and support for informal caregivers' individual needs and preferences. Internet-based interventions offer not only opportunities to tailor intervention content but also preferences regarding information delivery format (eg, video, audio, and text) [159]. In addition, tailoring has been shown to have a positive impact on the effectiveness of behavior change interventions [160]. Tailoring should be explored as an approach to enhance effectiveness and user engagement with e–mental health interventions.

Reflection on Updates to the CFIR

In 2022, after the thematic synthesis for this review was completed, an addendum to the CFIR was published [161] and an updated version of the CFIR was produced [162]. In the addendum, the authors specified that the CFIR is not appropriate for data from intervention users (ie, informal caregivers within the context of this review) unless intervention users play a role in intervention delivery or implementation [161]. CFIR authors classified data from intervention users as representing innovation determinants rather than implementation determinants [161]. The decision to exclude data from intervention users from the CFIR framework was motivated by the implementation of interventions primarily influenced by professional stakeholders involved more directly in activities related to intervention delivery or implementation [161]. Considering this addendum, it could be argued that the data included in this thematic synthesis, derived from informal caregivers, should have been excluded. However, given that e–mental health interventions rely on informal caregivers using interventions independently in their home environment, the perspective of informal caregivers could influence implementation and sustainability.

The CFIR defines contextual factors that can influence implementation; however, context is a broad concept, and different definitions and frameworks exist to define it [49]. In a scoping review that sought to review multiple implementation frameworks to comprehensively define the dimensions of implementation context [49], context was divided into 3 levels: micro, meso, and macro. Intervention users (eg, their views, needs, and preferences) were considered to fall within the microlevel [49]. Factors related to the implementing organization were classified within the mesolevel, with the wider implementation setting representing the macrolevel [49]. The CFIR framework captures the mesolevel and macrolevel of context; however, it does not include microlevel contextual factors. Researchers may wish to consider whether microlevel contextual factors may be important to consider in their implementation context.

Limitations

RCTs were retrospectively assessed using the PRECIS-2 tool to evaluate how pragmatic or explanatory each trial design was. Although the PRECIS-2 tool can be used retrospectively [163], poor reporting regarding the intended implementation context of the intervention under investigation within the trial posed a challenge to using the PRECIS-2 tool accurately. PRECIS-2 scores are dependent on understanding the intended implementation context of each intervention to assess how pragmatic design decisions within the trial were given the intended implementation context [39]. The intended implementation context is not often described in RCTs; therefore, assumptions about the intended implementation context were made to facilitate the PRECIS-2 scoring. For example, reviewers assumed that interventions were generally intended to be implemented across the entire country, unless otherwise specified in the trial. As the authors of the PRECIS-2 tool recognize [163], the use of the CONSORT extension for pragmatic trials [164] would facilitate the retrospective assessment of RCTs using PRECIS-2.

Risk of bias was evaluated using the Cochrane Risk of Bias 2.0 tool [81] in line with recommendations from the Cochrane Handbook for Systematic Reviews of Interventions [165]. However, research has shown that the Risk of Bias 2.0 tool can have low interrater reliability [166], which may impact the interpretation of the risk-of-bias assessments included in this review. Domain 4 of the Risk of Bias 2.0 assessment was often rated as high because the outcome assessors (which in the context of self-reported outcomes is the participant) were not blinded. The blinding of outcome assessors and others involved in RCTs is often a challenge, especially for RCTs of mental health interventions [167]. Various approaches to blinding participants and intervention providers in mental health trials have been proposed (eg, recruiting participants with no knowledge of mental health interventions, requiring that intervention providers have limited experience with mental health interventions); however, these approaches can be difficult to implement and have a negative impact on how pragmatic and generalizable the trial is [167,168]. Although the lack of blinding is a source of bias, participants not being blinded is a more pragmatic design choice and more closely reflects the conditions that could be expected if interventions were used in real-world settings.

Although OpenGrey was searched for gray literature, relevant gray literature, such as government reports, may have been missed, as these reports are not included in OpenGrey, and certain gray literature publication types, such as theses and abstracts, were not eligible for inclusion in this review. In addition, as searches were only conducted using English terms, gray literature in languages other than English may have been difficult to capture.

As discussed, given the recent addendum to the CFIR [161], some data included in the thematic synthesis (ie, data from informal caregivers) may not be universally considered relevant for implementation. However, this information provides important insights into the views of informal caregivers within the microlevel of context [49] and provides guidance on important design and implementation characteristics to consider to ensure the acceptability and uptake of e–mental health interventions among informal caregivers.

Conclusions

Although considerable attention has been given to the usability and acceptability of e–mental health interventions for informal caregivers of adults with chronic diseases, few studies have explored other factors that may influence implementation. In particular, factors related to outer and inner implementation

settings and the implementation process have rarely been explored. The views of professional stakeholders who are or will be involved in intervention implementation or delivery should be investigated to fill this gap. Given the challenges faced by e–mental health interventions when implemented in practice, implementation science research exploring not only implementation determinants but also implementation strategies are urgently needed.

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Authors' Contributions

CC was responsible for conceptualization, methodology, formal analysis, investigation, data curation, and writing—original draft, visualization, and project administration. EM was responsible for validation, formal analysis, investigation, and writing—review and editing. GF was responsible for validation, investigation, and writing—review and editing. JMZ was responsible for validation, investigation, and writing—review and editing. LvE was responsible for the methodology and writing—review and editing, supervision, and funding acquisition. RS was responsible for the methodology and writing—review and editing, supervision, and funding acquisition. JW was responsible for the conceptualization, methodology, validation, formal analysis, investigation, and writing—review and editing and supervision.

Conflicts of Interest

None declared.

Multimedia Appendix 1
PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklists.
[PDF File (Adobe PDF File), 472 KB - mental_v9i11e41891_app1.pdf]

Multimedia Appendix 2
Outcomes, Consolidated Framework for Implementation Research, search, support taxonomy.
[PDF File (Adobe PDF File), 431 KB - mental_v9i11e41891_app2.pdf]

Multimedia Appendix 3
Reasons for exclusion.
[PDF File (Adobe PDF File), 1016 KB - mental_v9i11e41891_app3.pdf]

Multimedia Appendix 4
Intervention characteristics, qualitative comparative analysis, Pragmatic Explanatory Continuum Indicator Summary 2, and risk of bias.
[PDF File (Adobe PDF File), 1522 KB - mental_v9i11e41891_app4.pdf]

Multimedia Appendix 5
Barriers and facilitators.
[PDF File (Adobe PDF File), 394 KB - mental_v9i11e41891_app5.pdf]

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Abbreviations

CFIR: Consolidated Framework for Implementation Research
CHESS: Comprehensive Health Enhancement Support System
CONSORT: Consolidated Standards of Reporting Trials
PICOS: population, intervention, comparators, outcomes, study designs
PRECIS-2: Pragmatic Explanatory Continuum Indicator Summary 2
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses-literature search extension
PROSPERO: International Prospective Register of Systematic Reviews
QCA: qualitative comparative analysis
RCT: randomized controlled trial

TIDieR: Template for Intervention Description and Replication

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Original Paper

The Implementation of Measurement-Based Care in the Context of Telemedicine: Qualitative Study

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Abstract

Background: The Measurement Based Care in Mental Health Initiative launched by the Department of Veterans Affairs in 2016 is an example of an evidence-based practice that uses patient-reported outcome measures (PROMs) to improve patient outcomes. The acceptance of measurement-based care (MBC) among Veterans Affairs providers is relatively high. However, there are barriers to MBC for telehealth providers. Health information technologies might afford opportunities to address some of the barriers related to the uptake of MBC.

Objective: This paper reports on an implementation effort to integrate MBC into mental health care telehealth practice using eHealth solutions.

Methods: Qualitative data were generated from 22 semistructured interviews with psychiatrists (n=4), psychologists (n=3), social workers (n=3), nurses (n=6), a pharmacist (n=1), and administrative staff (n=5) who provide telemental health care through a community-based outpatient clinic in the rural Midwestern United States. The interviews were conducted during the pilot phase of an implementation initiative to increase the adoption of MBC by revising clinic workflows to integrate the use of eHealth technologies. Data were analyzed using thematic analysis.

Results: Time burden and workflow issues were the most common barrier to provider adoption of MBC; sharing and reviewing pencil-and-paper measures and results in the same room was no longer possible in novel telehealth workflows necessitated by the COVID-19 pandemic. Providers voiced concerns about how long it would take to collect, adequately score, interpret, share, and document the PROMs during the telehealth visit. Concerns about time might also correspond to a gap in providers' familiarity with these assessments, greater comfort in assessing symptoms through clinical interviews, and being accustomed to using the assessments as screening tools more so than longitudinal outcome measures. Capacities associated with eHealth technologies may address workflow concerns and promote providers' understanding and use of the measures as tracking tools.

Conclusions: The need to use limited appointment time well was a top priority for telemental health providers. eHealth technologies provided operative supports that protect time in appointments by shifting when and how PROMs are collected. Bolstering providers' familiarity with how to use PROMs in the course of treatment may impact providers' buy-in by encouraging them to reconsider how sharing and acting on PROMs could be time well spent.

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KEYWORDS

telehealth; patient-reported outcome measures; measurement-based care; health information technology; data visualization

Introduction

The Measurement Based Care in Mental Health (MBC in MH) Initiative launched by the Department of Veterans Affairs (VA) in 2016 is an example of an evidence-based practice that uses patient-reported outcome measures (PROMs) to improve patient outcomes [1-3]. In measurement-based care (MBC) systems, patients complete standardized assessments such as the 9-Item Patient Health Questionnaire at regular intervals, and providers and patients use the results of these assessments to help them understand symptom presentation, identify targets for intervention, and monitor progress toward treatment goals [4]. By reviewing trends over time, providers and patients discern positive or negative changes to inform clinical decisions and psychotherapy approaches [4-6]. The VA MBC in MH Initiative highlights 3 essential components through a campaign using the slogan "Collect, Share, Act" [7].

VA providers are agreeable to MBC, but use is low and varies by discipline [8]. Early documented barriers ranged from an objective lack of resources (eg, protected time) to subjective concerns about the utility of the assessments relative to direct clinical interview [9]. Low provider use of MBC persists [10,11], even as evidence about the positive impact on outcomes supports the use of MBC [6,12]. Research has consistently documented that patients generally appreciate MBC, especially how it promotes shared decision-making [13-16]. The use of MBC dropped among VA providers at the start of the COVID-19 pandemic [17], presumably because of the increase in telemental health [18], although the full impact on the delivery of clinical care, for both patients and providers, is still being understood [19-21].

Health information technologies might address some of the barriers related to the uptake of MBC especially in the context of telehealth [22,23]. Prior to the COVID-19 pandemic, there was a call to better understand "remote measurement-based care (RMBC)" [24], that is, obtaining measures independent of appointment time using patient-facing electronic platforms to deliver assessments. Following the expansion of telemental health during the COVID-19 pandemic, researchers have just begun to publish findings about the integration of MBC into telemental health [20,25]. More research needs to be done, especially given the potential of eHealth technologies to address persistent time burden and workflow barriers by automating the asynchronous administration of PROMs. As well, there is very little information on the perceived utility or functionality of the visualizations that these technologies can produce to show a graphical representation of a patient's reported symptoms over time [24,26].

The VA is promoting the use of electronic capture of PROMs via eHealth solutions. Using these technologies, providers can administer PROMs electronically. The results are immediately scored and available for integration into the medical record without requiring synchronous administration or data entry by providers. This paper reports on an implementation effort to integrate RMBC into clinical telehealth practice using eHealth solutions. Our analysis explores the full meaning of providers' perceptions of time and workflow barriers and makes a novel finding about how the visualizations that the eHealth applications produce offer providers the opportunity to develop a narrative of treatment.

Methods

MBC in VA

The MBC in MH Initiative in VA launched in 2016; the goal of the initiative was to rapidly implement MBC and position MBC as the new standard of care [2]. To achieve this goal, members of the initiative rolled out MBC to 176 general and specialty care mental health programs, as well as Primary Care Mental Health Integration programs [2]. Researchers and implementation scientists involved in the implementation effort have published on the barriers and facilitators, as well as lessons learned during implementation [2,8,10,27]. They identified a lack of appropriate "technology" as a barrier to the implementation of MBC, although they suggested that "provider attitudes" and "organizational climate" also likely served as barriers [2].

The software platforms that were available at the VA in 2016 (Mental Health Assistant, VA Office of Information and Technology; and Behavioral Health Lab, Capital Solution Design) lacked both patient- and provider-facing features that would have facilitated a robust MBC practice [2]. Both Mental Health Assistant and Behavioral Health Lab were provider-facing software platforms, meaning that providers had to collect the data from patients, usually through direct interview or asking patients to complete pencil-and-paper forms. Providers or administrative assistants then had to enter the data into the medical record manually. Although some clinics were able to implement collection via a tablet in the waiting room, the predominant form of data collection was through direct assessment by the provider and hand entry into the medical record. Data from PROMs had to either be manually entered by the provider during appointments, entered with a tablet in the waiting room and then entered into the electronic medical record, or collected via pen and paper [10]. Some clinics explored using secure messaging via the patient portal (My Health*e*Vet; United States Veterans Health Administration) to

share assessments between patients and providers [25], but this method did not resolve either the time burden or workload barriers. At the time, patient-facing eHealth applications that have been used in the context of RMBC [24] were not available in VA and were not part of the initial implementation of MBC.

The VA has only recently started exploring patient-facing eHealth applications such as BHL Touch (Capital Solution Design) and MH CheckUp (VA Mobile). MH CheckUp was first rolled out in December 2020 and BHL Touch was rolled out in July 2021. Our implementation effort entailed understanding how to use these eHealth applications to facilitate the workflow processes associated with MBC, including collecting, sharing, and acting on PROMs. Human/user-centered design processes structured our implementation according to 4 phases: "Discover," "Design," "Build," and "Test" [28]. The purpose of our study was to develop workflows for clinicians that addressed the potential technological, organizational, and attitudinal barriers to the use of MBC. This paper reports on data generated during the "Discover" phase.

Setting

We conducted a rapid ethnographic assessment [29] of the workflows of providers based in rural community-based outpatient clinics (CBOCs) that served as satellite clinics for VA Medical Centers often located in urban settings. Providers were familiar with the routine collection of patient-reported outcomes in the context of protocols for evidence-based practices such as cognitive processing therapy, although this was not necessarily labeled as MBC. They had all also been made aware of new eHealth technologies such as MH CheckUp and BHL Touch; however, their engagement with these applications was dependent upon their own interest. Of all of the clinicians we talked to (n=18), there were 5 people who already had some experience using these eHealth applications in the context of treatment.

This work supported the operational goals of the Office of Mental Health and Suicide Prevention and the Office of Rural Health within the VA.

Ethical Considerations

Our project procedures were reviewed by the University of Iowa Institutional Review Board (# 202009601) and determined to be non–human subjects research. Additionally, the project was reviewed by the Iowa City VA Research and Development Committee.

Participants

We recruited staff members (n=26) who provide telemental health services to patients at 2 CBOCs in the rural Midwestern United States. A total of 22 staff members agreed to participate; they included psychiatrists (n=4), psychologists (n=3), social workers (n=3), nurses (n=6), a pharmacist (n=1), clerical staff (n=2), program managers (n=2), and the regional telehealth point of contact (n=1). Although we only report on interview data with psychiatrists, psychologists, social workers, pharmacists, and the telehealth point of contact in this paper, it was important to speak with clerical staff, nurses, and program managers to understand the organizational climate of the CBOCs. Not only did interviews with these individuals help us ask better questions of the providers, but they will also inform the decisions we make in subsequent phases of the study, including "Design" and "Build." Moreover, some of these supporting staff members were part of the workflow related to collecting PROMS from patients.

Procedure

We conducted direct observations of weekly web-based team meetings and semistructured interviews over videoconferencing. The program managers on each of the teams facilitated our entry into the weekly team meetings. We started observing weekly team meetings in December 2020 and continued through 2022. We took detailed field notes of the discussion of workflows that shaped the day-to-day work of the teams. Attending weekly team meetings served four purposes: (1) it acclimated the qualitative analysts (who are both trained in anthropology and not clinicians) to the technical language that the team members used when talking about their work; (2) it helped in the development of rapport, so that it was ultimately easier to recruit participants for interviews, and during those interviews, both the participant and interviewer had a sense of shared experience; (3) it helped us notice potential workflow and organizational barriers to the implementation of the eHealth technologies; and (4) in helping us notice those potential barriers, we were able to tailor our interview probes to the context. We maintained our presence in weekly meetings even after the interviews were completed to track emerging workflow and organizational barriers as we moved into the "Design" phase of our implementation. We used this method as a workaround when our original plan to conduct site visits was derailed due to COVID-19 travel restrictions.

Our early field notes informed the development and refinement of our interview guide (Multimedia Appendix 1). Our interviews addressed staff perceptions of using PROMs in clinical care; their experiences integrating standard assessments into individual appointments, as well as treatment over time; and finally, their techniques for reviewing the assessments with their patients. We recruited staff members via email and conducted interviews from May 2021 to October 2021. Participation was voluntary and we obtained verbal consent. Interviews were recorded and transcribed; they ranged from 18 minutes to 60 minutes and averaged 35 minutes.

Data Analysis

In all, 2 qualitative analysts conducted a thematic analysis [30] of the interview data. The analysts coded each interview together. Using inductive and deductive coding [31], we identified themes related to workflow, time, patient flow, data management, technology, job role, protocols, treatment approach, and perceptions of MBC.

Results

Overview

The barriers that have been documented for in-person care were also barriers to MBC in the context of telehealth. We heard providers voice concerns about how long it would take and how much coordination it would entail to adequately score, interpret,

share results with patients and document the PROMs. We also found that the providers who were already engaging with eHealth applications noticed how these technologies can help resolve some of the time burden and workflow barriers in both telehealth and in-person visits.

In asking providers to reflect on their experiences with MBC, we surfaced latent barriers couched within the larger umbrellas of workflow and time. Concerns about time might correspond to providers' training and preference in assessing symptoms through clinical interviews rather than standard assessments. These characteristics, combined with being accustomed to using the assessments as screening tools more so than longitudinal outcome measures, might contribute to providers' hesitancy to use MBC as a tool for shared decision-making and treatment planning.

In our discussions with providers, we made a novel finding about the potential of the visualizations that the eHealth technologies can create. Researchers have noted how tracking patient's responses over time using visualizations is an unexplored potential benefit of RMBC with eHealth technologies [24,26]. We found that the visualizations helped providers develop a narrative about the course of the patient's illness and understand trends of symptom severity over time.

Telehealth, MBC, and Workflow

At the time of the interviews, providers were still adjusting to changes in their workflow precipitated by the COVID-19 pandemic. The workflows providers had been using to administer PROMs were no longer possible. One psychiatrist explained how, prior to the pandemic,

> *Usually the patients...would check in in a kiosk and that would flag them to fill out or to receive a paper copy of a questionnaire, And then the patient [would] fill it out on paper and then someone physically on site would upload that into...our electronic medical record, and then we would get it that way. And then the pandemic hit and everyone's doing video visits to home, which is very exciting. And now trying to catch up and find a way to capture um, that workflow, but all electronically.* [Psychiatrist and telehealth point of contact, multiple CBOCs]

When we spoke with providers, they had been using several telehealth formats, including phone visits and video-based visits such as video telemedicine and VA Video Connect (VA Mobile) visits. For video telemedicine visits, patients come into the CBOC and have their visit via video chat with a provider who is either in another room or at another clinic location. For VA Video Connect visits, patients stay at home and have their visit with a provider who is at a clinic or at home. Providers anticipated workflow barriers to integrating PROMs into telehealth appointments, including questions about when to distribute the PROM, how to get it back, and how to get it back in time for it to be used during the appointment. One psychiatrist described their experience in using MBC during in person visits and how "there's a lot of pieces." They said,

> *So when I think about Tele Health, there's the phone which we're trying to go away from, and then there's [VA's telehealth platform]. So some of my patients like I log in, it's the start of the appointment we're both there, fantastic. We're having an appointment that's great and I'm trying to get through everything that I need to do to actually take care of a patient. I'm trying to throw in some clinical reminders when I remember. I'm trying to schedule them for their next appointment. And then how I would actually do the measurement based care part? I'm not sure because I'm used to being able to like throw them a measure while I multitask and now I can't...in a perfect scenario, if they show up, it's possible that if we had a way for [our teleadministrative staff] to know, like "hey, this person needs XY and Z," then maybe [the Veteran] could be handed that, but then they're like trying to do it during the appointment. Do they turn it in after? Where does it go? Uhm, is there something that they could be sent ahead of time that they could do at home and it could be ready in time for the appointment?* [Psychiatrist, CBOC 1]

The use of electronic applications to conduct assessments prior to scheduled visits addressed many of the workflow issues that this provider described. Some providers were already making use of available eHealth technologies on an individual basis. With these technologies, providers schedule assessments in advance of appointments. Patients receive a link over email or SMS text message, and they complete the assessments; the results are shared and discussed in the upcoming mental health visit. Some applications allow the provider to sync results directly into the electronic medical record, so a patient's responses to assessments are easily documented, integrated into the visit note, and shared with all the different providers that care for that patient within that institution. A few providers we spoke to had already started using some of the eHealth applications. One of these psychiatrists said,

> *When I ask Veterans, "Oh how did it go on your end?" the majority answer on their phones...So it seems like text is the best--, has had the most success or the easiest for them to respond. I like that I don't have to do anything. I can just upload it and it's right there.* [Psychiatrist and telehealth point of contact, multiple CBOCs]

A social worker reported a similar experience:

> *What I like about it is I can schedule as many...I can have them do more than one...like if I'm seeing somebody weekly and I want to know how they're doing with whatever one of the assessments I choose to use. I'm able to put it on a weekly basis without having to go back in there and redo it. So that's what I like about it and then I'm able to see it in [the electronic medical record]...so that morning...before their appointment I can see what the results were.* [Social worker 1, CBOC 2]

Providers who had already started using some of the eHealth solutions helped us notice how the functionality of the applications could solve some of the workflow barriers identified

by providers who had not yet tried to use the eHealth technology.

Telehealth, MBC, and Time

Confirming findings already published about the use of MBC, many providers mentioned how time burden was a potential barrier. However, we also noticed that when providers talked about time, they often talked about how they already used the clinical interview to generate the same information the assessments would capture. The relative value of MBC to clinical interviews was not clear. A psychologist described how,

> *It is time consuming and...it's either, it doesn't add as much as I would want it to the clinical interview...and I have to ask those questions anyway, um, PHQ-9 [9-item Patient Health Questionnaire] and GAD [General Anxiety Disorder], I feel like I do them and they don't always lead to a more in-depth conversation.* [Psychologist 1, CBOC 2]

Providers felt that it took a long time to do the assessments because they were not sure why they were doing them, or what value the assessments added. For example, one psychiatrist talked about how,

> *It takes time to do it, and then once you get it, you have to then take more time to understand...what it's actually saying. Meanwhile, you could just do like a narrative thing or subjective interview where you're...you talk to them about their sleep and you immediately get to, 'I'm sleeping too much' and then you have the conversation about sleeping.* [Psychiatrist 3, CBOC 1]

eHealth technologies addressed this concern somewhat by moving some of this work outside of the appointment, as patients were encouraged to complete the PROMs on their own time.

Telehealth, MBC, and Building a Narrative

Helping to resolve workflow and time barriers would not address providers' preferences for understanding a person's lived experience through clinical interview. On the one hand, providers voiced concern that the score on an assessment is a snapshot in time and often decontextualized from a person's lived experience. One psychiatrist worried how,

> *They come in and they're under a lot of stress because their dog died, and their scores are gonna shoot up...with time it should come, you know, back down, and I do the treatment, it will keep improving. But that'll take time to track.* [Psychiatrist 3, CBOC 1]

The use of the same PROMs as both a screening tool and an MBC tool led to persistent confusion. Rather than using the assessments to shape a meaningful treatment plan and inform clinical decision-making, most providers continue to view standard assessments as screening tools rather than tools for longitudinal assessments of patient-reported treatment outcomes. Moreover, many providers lacked training about the specific content validity and psychometrics of the available measures. Another psychiatrist remembered how,

> *I think initially I had to like look [many of the scales] up, --not all of them, but lots of them. Like I [didn't] know what [some were]...like are these useful scales?...So that took a lot of time and then [it] ended up being like most of them [were] not really useful for my purposes...and also I don't think...the information [for] interpreting the results...you have to look that up separately if needed.* [Psychiatrist 1, CBOC 2]

Providers that used the assessments as more than screening tools talked about using the patient's responses to shape a narrative about treatment. One social worker, adept at cognitive processing therapy for posttraumatic stress disorder, explained how the assessments help her understand how treatment was going. She described how,

> *I'm doing something like cognitive processing therapy, and I do a consistent uh, PCL [posttraumatic stress disorder symptom rating scale]...I expect those symptoms when we start to increase and spike, and then I expect to see them decrease and so if I don't see that happening, if I don't see that spike, then I-I know we're not really touching on things that are bothering them, that we're still really surface and if over time I don't see a decrease, I know that we're really not scratching what we need to hit to get them to process the information well enough.* [Social worker 1, CBOC 1]

eHealth technologies offer providers the ability to visualize data from the assessments to track the trajectory of a patient's symptoms over time. The graph might be very useful for helping providers build an account of the course of treatment. One social worker reflected on their experience with visualizations provided by eHealth technologies prior to working with the VA; they remembered how,

> *I had one guy...it was actually pretty amazing...he was super depressed and then...you could see...right along with his mood...his chart totally changed, and he actually got to a point where [he said] "I'd rather actually pay for going to jujitsu classes than therapy. At this point, I'm feeling pretty good."...I thought that was a cool way to be able to do it.* [Social worker 2, CBOC 1]

The visual functionality reinforces the assessments as tracking tools, as the graph potentially facilitates conversations about "trends over time." Providers no longer have to analyze and create a way to present the long-term data, making it easier to visualize a patient's progress over time. One psychiatrist who had already started using one of the eHealth technologies reflected how,

> *I like how quickly it shows the trend...very user-friendly...I think a big value is having the response before the start of the appointment...it's really nice going into the appointment knowing at least on paper things look better, things look worse, than when I last saw them...So you're already kind of thinking a little bit about what the next step might be...it kind of helps tailor [my plan] right off the bat a little.* [Psychiatrist and telehealth point of contact, multiple CBOCs]

Our findings indicate that not all providers were sure how to use the assessments as a method for developing an understanding of a patient's lived experience and may have perceived the time spent doing the assessments as time not spent effectively. The above reflection, from a psychiatrist who felt successful using the PROMs to shape their clinical decisions, suggests that eHealth technologies can help providers develop a narrative of treatment that they can use to tailor their treatment plans.

Discussion

Principal Findings

Promoting the uptake of MBC in telehealth requires addressing the issue of time burden, which necessitates both (1) acknowledging the limited time in appointments by facilitating the administration of PROMs via SMS text messaging or email before appointments and (2) satisfying telemental health providers' need to use time well by increasing their familiarity with how to use the assessments to measure response to treatment. eHealth technologies facilitate the administration of assessments prior to appointments and, thus, pose a pragmatic solution to concerns about time, especially in the context of telehealth. The additional functionality associated with eHealth technologies (eg, graphs that visualize patients' responses over time) has the potential to increase providers' awareness of assessments as tracking tools that can facilitate setting goals and following progress toward those goals rather than simply as screening tools.

Comparison With Prior Work

Our findings confirm and extend findings in the extant literature about how time burden is a formidable barrier to the adoption of MBC [9,10]; further, our findings suggest that provider perceptions of time burden are related to unfamiliarity with PROMs as means for tracking symptoms over time. Not all mental health care providers receive training about psychometrics and the validity and reliability of standard mental health assessments. Targeted training on specific PROMs, as well as increasing awareness of the aspects of MBC, including Collect, Share, and Act, may increase provider use. Providers may reconsider the time it takes to administer (Collect) and discuss (Share and Act) as an invaluable use of time if they better understand how the information gleaned from the assessments (ie, objective measures of symptoms) can be used in concert with clinical interviews (ie, patient-lived experience) to shape treatment.

Limitations

Although we recruited a diversity of providers from different disciplines and roles within the clinic, our sample is small and only represents 2 CBOCs, both of which were part of the VA health care system. Although our findings would be strengthened by comparison to more diverse clinic settings, our findings reflect previous studies' findings in different settings; moreover, our qualitative methods allowed us to expand upon and clarify this previous work. Our sample size will grow as our implementation effort continues and we continue to report on our findings.

Conclusions

The adoption of MBC into existing professional practice and the implementation of such programming into a telehealth workflow is a complex process. Promoting the uptake of MBC in telehealth requires addressing the issue of time burden, which necessitates both (1) acknowledging the limited time in appointments by facilitating the administration of PROMs before appointments and (2) satisfying telemental health providers' need to use time well by increasing their familiarity with how to use the assessments to set treatment goals. eHealth technologies facilitate the administration of assessments prior to appointments and, thus, pose a pragmatic solution to concerns about time. The additional functionality (eg, graphs that visualize patients' responses over time) has the potential to increase providers' awareness of assessments as tracking tools that can facilitate setting goals and following progress toward those goals.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Interview guide.
[DOCX File , 15 KB - mental_v9i11e41601_app1.docx]

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Abbreviations

CBOC: community-based outpatient clinic
MBC: measurement-based care
MBC in MH: Measurement Based Care in Mental Health
PROM: patient-reported outcome measure
RMBC: remote measurement-based care
VA: Department of Veterans Affairs

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