Personalized High-Frequency Monitoring of a Process-Oriented Psychotherapeutic Approach to Seizure Disorders: Treatment Utilization and Participants' Feedback

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High-frequency monitoring of psychological variables has been recommended to monitor and manage psychotherapeutic processes. However, high-frequency monitoring might be regarded as burdensome for participating patients. This feasibility study applied the concept of high-frequency treatment monitoring in patients with seizures and psychiatric comorbidities in an outpatient neurology service. The treatment monitoring entailed the development of a personalized process questionnaire, daily online monitoring, and regular reflection of the current time series graphs. Participants' feedback on user-friendliness and usefulness of this treatment monitoring was evaluated quantitatively and qualitatively. Participants' compliance rates (CRs) of daily self-assessments after 6 months were correlated with their quantitative feedback on user-friendliness and usefulness and the number of scheduled treatment sessions during this time period. Twenty patients, 15 women/5 men, median age 48 years (range: 23–73 years), were recruited. The median number of scheduled sessions was 11 sessions (range: 6–22). Participants reported a high overall satisfaction with the user-friendliness and usefulness of treatment monitoring. No notable correlations could be found between CRs and quantitative feedback nor between CRs and the number of scheduled treatment sessions. Personalized high-frequency monitoring of psychological variables seems to be feasible to monitor and manage process-oriented psychotherapeutic care in patients with seizures and psychiatric comorbidities. The results support the user-friendliness and usefulness of high-frequency monitoring and suggest that high-frequency monitoring may be suitable for monitoring of low-frequent treatment sessions and patients with attendance issues.

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Clinical Impact Statement
Questions: This study investigated if participants in process-oriented and personalized psychotherapy for patients with seizures find the daily completion of personalized questionnaires user-friendly and useful. *Findings*: Participants reported a high overall satisfaction with the user-friendliness and usefulness of the high-frequency treatment monitoring and particularly appreciated insights into connections between self-care behaviors and symptom alleviation. *Meaning*: High-frequency monitoring of personalized psychological variables seems to be feasible to monitor and manage psychotherapeutic treatment in patients with seizures and psychiatric comorbidities. *Next Steps*: Future analyses of the correlation of time series data with pre- and post-intervention outcome measures may deepen our understanding of precursors of non-responsiveness to psychotherapy and efficient resource allocation within psychotherapeutic treatment.

Seizure Disorders and Comorbidities

Epilepsy is one of the largest groups of serious chronic neurological conditions associated with substantial comorbidity including psychiatric disorders and cognitive dysfunction (Banerjee et al., 2009; Sirven, 2016). Psychiatric disorders such as depression, anxiety, and psychotic disorders affect one in three people with epilepsy and are due to shared neurobiological mechanisms as well as psychosocial consequence of having epilepsy (Mula et al., 2021). Psychotherapy has been recommended as a complimentary treatment to improve quality of life and reduce psychiatric comorbidity in patients with epilepsy (Michaelis et al., 2018a). Psychogenic nonepileptic seizures (PNES) are an important differential diagnosis and a common neuropsychiatric comorbidity of epilepsy (LaFrance et al., 2013). Psychotherapeutic interventions have been recognized as the treatment of choice for PNES (Goldstein et al., 2020).

Personalized Seizure-Related Psychotherapy

Andrews and colleagues have developed a modular seizure-specific integrative psychotherapeutic intervention outlined in the workbook *Taking Control of Your Seizures* (Reiter et al., 2015). Meaningful reductions in seizure frequency have been observed in previous retrospective (Michaelis et al., 2012) and prospective (Reiter & Andrews, 2000) uncontrolled trials in epilepsy and in a randomized controlled trial in PNES (LaFrance et al., 2014); improvements in general and seizure-related self-efficacy and sense of mastery have been reported by participants in a qualitative investigation (Michaelis et al., 2018b). German treatment modules (see Table 1) have been developed based on the approach outlined in this workbook (Heinen et al., 2021). The development of the modules was informed by the systematic review of psychological interventions for epilepsy that have been recommended to get incorporated into comprehensive care for seizure disorders based on the current evidence (Michaelis et al., 2018a). The core of this evidence-based integrative therapeutic framework outlined in the workbooks involves *cognitive behavioral therapy (CBT)* and *mindfulness-based cognitive therapies (MBCT)*, that is, the practice of nonjudgmental awareness of uncomfortable feeling states. The intervention's overarching goal is the enhancement of self-efficacy and health-related quality of life in patients with seizures by strengthening the use of existing resources (*resource-orientation*). The approach also integrates elements from *motivational interviewing* (treatment module 2), *positive psychology* (treatment module 8), *psychodynamic psychology* (treatment module 10), and *logotherapy* (treatment module 12). The acceptability and comprehensibility of this work material have previously been demonstrated (Heinen & Michaelis, 2020; Michaelis et al., 2018a). The order of application of the treatment modules 3–12 is interchangeable to accommodate the individual case formulation and patient preference.

Process-Oriented Psychotherapy Models

Intervention protocols often involve a predefined treatment length, frequency, and total number of intervention sessions. Dropouts and noncompliance are then usually defined in relation to these predefined intervention protocols. However, the question has been raised if heterogeneous patient populations may require the application of intervention protocols that entail sufficient flexibility to allow for a complex needs-oriented adaptation of psychotherapeutic treatment frequency rather than a uniform "one size fits all"

Table 1
Treatment Modules of the German Version of the Approach "Taking Control of Your Seizures"

Titles of treatment modules
Treatment module 1: Introduction: Learning About Seizures
Treatment module 2: Making the Decision to Begin the Process
Treatment module 3: Talking About Seizures
Treatment module 4: Reflecting Upon your Medication Therapy
Treatment module 5: Learning to Observe Your Seizure Triggers
Treatment module 6: Mindfulness Training
Treatment module 7: Identifying and Interrupting Your Aura
Treatment module 8: Fostering Positive Attitudes
Treatment module 9: Dealing with External Life Stressors
Treatment module 10: Dealing with Internal Issues and Conflicts
Treatment module 11: Understanding Other Seizure Symptoms
Treatment module 12: Personal Growth: An Ongoing Process

Note. The order of the treatment modules 3–12 is interchangeable and can be adapted to accommodate the patients' preference.

approach (Lambert et al., 2005; Lutz et al., 2011; Schiepek et al., 2020a). So far, *stepped care models* have been recognized as an opportunity to realize an increased personalization of applied treatment methods, treatment duration, and number of sessions in academic and regular outpatient settings. First promising results have been described for disorders such as depression (Härter et al., 2018), weight control (Black & Threlfall, 1986), eating disorders (Wilson et al., 2000), generalized anxiety disorder (Newman, 2000), panic disorder (Otto et al., 2000), and alcohol problems (Sobell & Sobell, 2000). Informed by an initial mental health assessment stepped care models apply the most adequate treatment of lowest possible and highest necessary intensity while systematically monitoring the patients' treatment progress (Bower & Gilbody, 2005). The next appropriate step is offered if a patient does not benefit from the initially offered intervention step. Therefore, it is assumed that stepped care offers the least intrusive and cost-efficient way to allocate scarce resources (van Straten, 2010). The British clinical guideline by the *National Institute for Health and Care Excellence (NICE)* has thus recommended the adoption of stepped care for depression. However, one of the largest recent cluster-randomized controlled trials investigating a collaborative stepped care model for depression has not found evidence for cost-effectiveness of stepped care in comparison to treatment as usual (Brettschneider et al., 2020).

Nonetheless, the stepped care approach introduces the principle of adopting a flexible approach to determining treatment duration and number of sessions by accommodating the patients' needs and progress. Up to now, the application of such process-oriented psychotherapeutic care models has not been investigated in people with seizures. One reason might be the challenge of systematically monitoring personalized treatment processes.

Systematic and Personalized High-Frequency Monitoring of Treatment Processes

The assumption that score changes on self-report measures that prescribe both the question and the response category to patients adequately reflect psychotherapy-related changes has been the subject of a long debate. Thus, a multimethod, multiperspective approach has been recommended to complement standard outcome assessments in order to investigate psychotherapeutic processes and outcome: First, the inclusion of personalized quantitative measures that capture complaints as well as goals that are meaningful to individual clients; second, qualitative approaches that employ open questions and yield accounts of individual clients' experience in their own words; third, the therapists' oservations of clients' in-session behavior; and fourth, the systematic assessments of various characteristics of the therapeutic work relationship by clients and therapists (Hill et al., 2013).

Frequent assessments of personalized quantitative measures can be realized by personalized process questionnaires (Schiepek et al., 2016a, 2018). Such personalized process questionnaires can be developed with patients informed by idiographic systems modeling of a participant's dynamics of thoughts, emotions, and behavior obtained during an initial semistructured interview at the outset of therapy (Schiepek et al., 2015, 2016a). Mapping the interconnections of these variables creates a graphic representation of relevant aspects of a patient's current mental world in his/her own words— *the idiographic system model (ISM*; see Figure 1 as an example). Several components of the resultant ISM can then be used to develop items for a personalized process questionnaire for each patient (see Supplemental Materials Table S1 as an example). Such a questionnaire aims at assessing resources, strengths, and goals on the one hand, and complaints, stressors, and/or discomfort on the other hand. Whenever it seems reasonable, visual analog scales (VASs) are used instead of Likert-type scales to increase granularity. VAS can be transferred to a range from 0 to 100 for representation in time series graphs. Item selection and item wording are guided by the patient's attribution of meaningfulness ("Is this item meaningful enough, so that it is worth taking the time to shortly reflect on it once a day?"). Item wording further helps to elaborate the meaningful aspects of an item: for example, *sleep quality* (VAS 0: *bad* to 100: *good*) versus sleep quantity, for example, *bedtime (last night)*, VAS 0: *early (prior to 2 a.m.)* to 100: *late (after 2 a.m.)*. The discussion of these resulting time series graphs, that is, the detailed visualization of the dynamics of the patients' data entries, can be integrated in psychotherapy sessions to stimulate an exchange of interpretations between clients and therapists.

This frequent psychological data collection can be technically realized by using the *Synergetic Navigation System (SNS)*. SNS is a web-based application that allows for the assignment of various questionnaires at sampling rates up to free choice (Schiepek et al., 2015, 2018). Data can be entered using web-compatible devices. Data privacy and data security are guaranteed by https pages, anonymized usernames, and passwords.

Until now, only few studies in outpatients with epilepsy have integrated frequent and equidistant electronic data acquisition and none of these studies have obtained personalized variables (Haut et al., 2013, 2018). The monitoring of subjective experiences in close temporal proximity to their actual occurrence may reduce memory biases and might therefore be particularly beneficial in patients with seizures who commonly suffer from memory problems (Sirven, 2016). Thus, the integration of high-frequency monitoring of psychological variables has been recommended to allow for the monitoring and *cooperative process-oriented management* of psychotherapy in patients with seizures and psychiatric comorbidities, that is, flexible session scheduling that considers the patients' needs, progress toward identified goals and co-decision-making (Modi et al., 2017). Figure 2 illustrates how the documentation of a de novo worsening of symptoms in a time series graph led to an increase of the sessions' frequency. However, so far the variability and attendance of sessions scheduled through cooperative process-oriented management have not been investigated, and we do not know if participating patients regard high-frequency monitoring as user-friendly and useful. The entirety of therapy management that comprises the development of an ISM, a personalized process questionnaire, daily online monitoring, regular feedback sessions, and cooperative process management is called *synergetic process management* (see Figure 3).

Study Aims

This uncontrolled feasibility study aimed at the investigation of process-oriented psychotherapeutic care in patients with seizures in an outpatient neurology service. Our model of care was based on an individual case formulation informed by a semistructured resource-oriented interview and took into account the bidirectional relationship between seizure disorders and mental health. Therapy management took into account all elements of synergetic process management (see Figure 3). In this study, we particularly aimed at the investigation of the variability and attendance of scheduled sessions, and patients'

Figure 1
Idiographic System Model
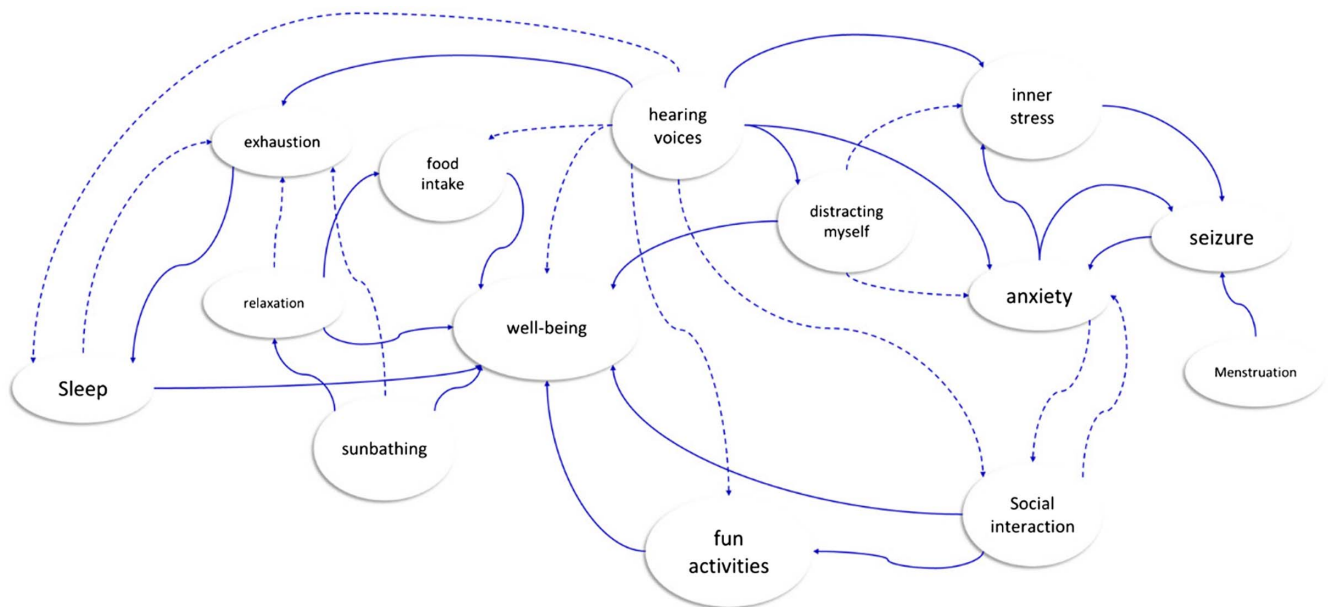
Note. A variable such as "hearing voices" is written down and the notes of the semistructured interview are checked for other variables that are connected to it. Connected variables such as "anxiety" and "sleep" are written down and all variables are linked with a continuous or dotted arrow, indicating whether there are positive relations (continuous arrow: increase in "hearing voices" leads to increased "anxiety") or negative relations (dotted arrow: increase in "hearing" leads to decreased "sleep"). See the online article for the color version of this figure.

evaluation of user-friendliness and usefulness of high-frequency monitoring. We anticipated that the application of personalized questionnaires would be user-friendly and helpful for the participants, and that a higher number of scheduled treatment sessions as well as higher ratings of user-friendliness and usefulness would correlate with higher compliance rates (CRs) of daily self-assessments.

Method

Ethical Aspects

Ethical approval was obtained from the ethics board of the University Witten/Herdecke (UWH, 210/2018). All patients gave written informed consent to participate in the intervention and for pseudonymized data to be included in publications.

Recruitment of Patients

This pilot study was conducted in the outpatient clinic of the neurology department of a community hospital in Germany (Gemeinschaftskrankenhaus Herdecke). We aimed at recruiting 20 German-speaking adults (≥18 years) with a diagnosis of epilepsy according to the criteria of the International League against Epilepsy and/or PNES and interest in partaking in psychotherapeutic treatment. The sample size was predetermined at the outset for pragmatic reasons. Exclusion criteria involved severe psychiatric comorbidity that would have warranted hospitalization instead of an outpatient psychotherapeutic approach (e.g., suicidality). The Mini-DIPS was used by RM as a standardized interview to evaluate lifetime and current symptoms of mental health disorders (Margraf et al., 2017; Margraf & Cwik, 2017). This interview is widely used in German

speaking countries, extensively validated, feasible, and freely available. RM has had supervised training in the application of the Mini-DIPS during her 3 years of psychotherapy training and the mandatory 1-year psychiatry rotation during her neurology residency. Neurologists working in the hospital's neurology department and three community-based neurologists were instructed to hand out leaflets with information about the treatment program to patients with epilepsy and psychological issues (such as depressive symptoms and anxiety) and/or PNES.

Personalized Intervention Model

The German version of the patient workbook *Taking Control of Your Seizures* was used during the intervention (Heinen et al., 2021). The intervention involved regular one-to-one sessions with the therapist (RM, neurologist, and psychotherapist with >10 years of work experience) provided in person or through video telehealth visits with a maximum duration of 60 min. Session scheduling involved cooperative process-oriented management. At the end of each therapy session, the next session was scheduled together with the patient by taking into account the patient's codecision, individual circumstances, and progress toward the identified personal goals of therapy. The minimum interval between two sessions was 1 week; the maximum interval was 4 weeks.

Personalized High-Frequency Monitoring

A personalized questionnaire was developed with each participant informed by idiographic systems modeling (Schiepek et al., 2016a; see Figure 1 and Supplemental Materials Table S1 as examples).

Figure 2

Rumination Intensity and Adjustment of Treatment Frequency Through Cooperative Process Management
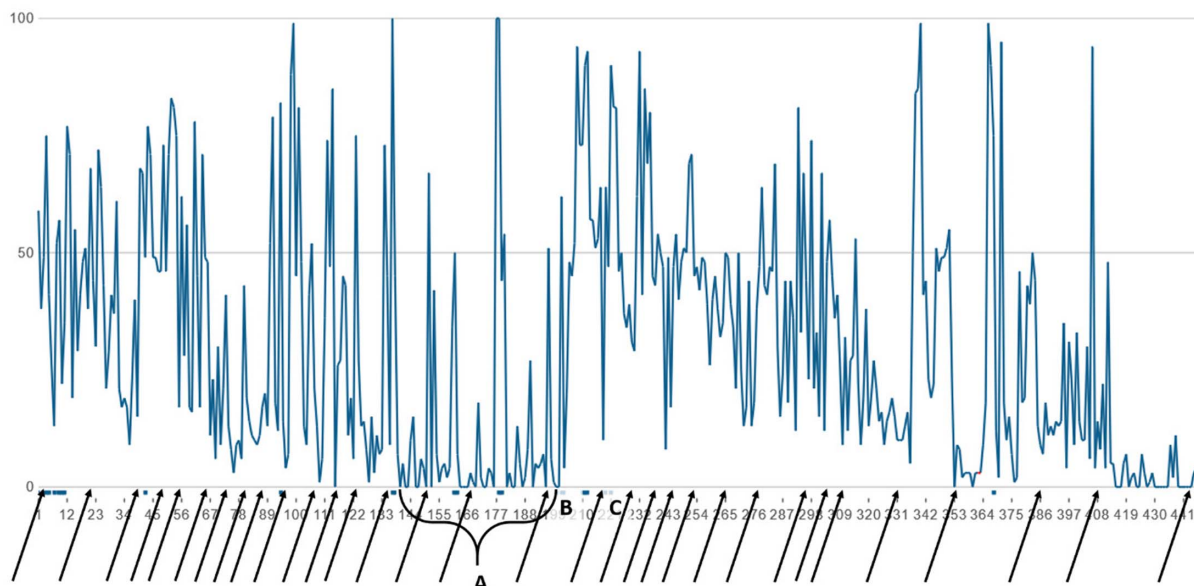
Note. Daily ratings of the item "Today I ruminated" of a 46-year-old female patient with juvenile myoclonic epilepsy and recurrent major depressive disorder; *Y*-axis indicates answers on a visual analog scale (0: *no, not at all* to 100: *yes, very much*); *X*-axis indicates consecutive daily responses over time; arrows indicate treatment sessions attended by the patient. The time series shows a phase marked A during which days with less rumination outweighed days with increased rumination. Note that phase A is characterized by less frequent sessions. This phase was followed by a phase characterized by a sudden increase of rumination (the beginning of which is marked B). This sudden increase was triggered by two life events: the patient's return to work and a cancer diagnosis in a close relative. In addition, the antidepressant pharmacotherapy had previously been tapered by the treating neurologist as per the patient's wish. The documentation of the sudden increase of rumination led to an increase of the treatment sessions' frequency as a result of cooperative process management (the beginning of which is marked C). See the online article for the color version of this figure.

The resulting time series graphs (see Figures 4 and 5 as well as Supplemental Materials Figures S1 and S2 as examples) were discussed regularly with the participants during psychotherapy sessions. Patients had access to their own diagrams via the SNS website independent from psychotherapy sessions.

Assessment of User-Friendliness and Usefulness

The application of the personalized questionnaires was quantitatively judged in the dimensions "user-friendliness" and "usefulness" by 14 items rated on a VAS scale (see Supplemental Materials Table S2 for full questionnaire), for example, "How do you judge the user-friendliness of the application of the SNS?" (VAS 0: *very bad* to 100: *very good*) and "The application of the SNS facilitated new perspectives and insights into my experience and behavior that I had not been aware of before." (VAS 0: *not at all* to 100: *very clearly*). Every item included one to three open questions to be answered with free text. Participants were also asked to evaluate if the application had influenced their relationship with the therapist (VAS 0: *very negatively* to 100: *very positively*) and their satisfaction with the discussions of time series graphs during psychotherapy sessions (VAS 0: *very unsatisfied* to 100: *very satisfied*).

Data Analysis

The participants' number of scheduled treatment sessions and quantitative assessment of the application of the SNS were summarized using descriptive statistical methods. Qualitative content analysis (Mayring, 2015; Michaelis et al., 2018b) of the participants' written responses to open questions was conducted in an interprofessional group consisting of two neurologists (RM, FE) and two psychologists (GS, YH). Written responses were paraphrased, reduced, summarized, and coded by RM. Main themes were identified through the inductive analysis of the written responses of five participants. This thematic framework was then applied to the written responses of all other participants by the interprofessional group. Disagreements were discussed in the research group until consensus had been reached to reduce bias and ensure reflexivity. Relevant passages were translated from German into English for publication purposes. The references of supporting quotes include the respondents' identifier (P1, P2, P3 . . . P20), CR, and frequency of scheduled sessions (L = low treatment frequency, M = moderate treatment frequency, H = high treatment frequency). Participants' % CRs during the first 6 months (i.e., 180 days) of treatment ([number of completed questionnaires/ 180 days] × 100) were correlated with their quantitative feedback and the number of scheduled treatment sessions during this time. Two-sided *t* tests were performed. The *p* values were corrected by the false-discovery rate algorithm with a Matlab implementation of the R-function *p.adjust* (Radua & Albajes-Eizagirre, 2010). Daily ratings of the illustrative time series graphs were exported as excel files. Daily ratings of the items during the featured time ranges were correlated using excel (Schiepek et al., 2020b).

Figure 3
Synergetic Process Management
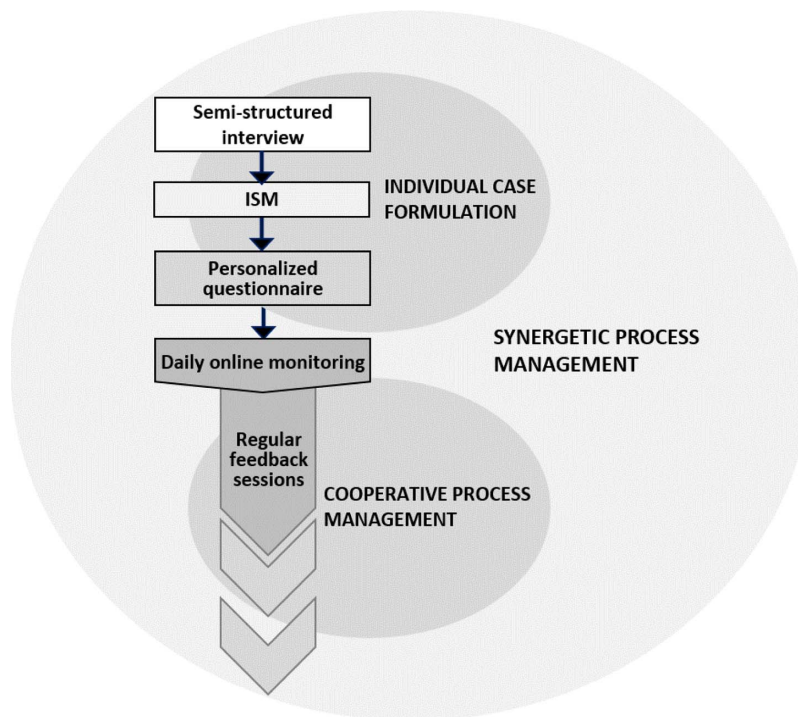
Note. Our model of care was based on an individual case formulation informed by a semistructured resource-oriented interview. Therapy management entailed the development of an idiographic system mode (ISM) and a personalized process questionnaire, daily online monitoring, and regular feedback sessions based on the time series graphs. Process-oriented treatment planning included cooperative process management (Schiepek et al., 2015). See the online article for the color version of this figure.

Results

The first 20 patients, 15 women/5 men, median age 48 years (range: 23–73 years), who indicated interest in treatment participation were consecutively enrolled after eligibility was confirmed by RM. All patients had at least one current psychiatric comorbidity (see Table 2 for patient characteristics). The majority of patients had both a depressive and an anxiety disorder (12 patients, 60%) according to standardized interview. Three patients had comorbid PNES previously diagnosed by video-Electroencephalography (Video-EEG) monitoring; two patients had previously been diagnosed with borderline personality disorder by their treating psychiatrists. Three patients had a previously diagnosed intellectual disability (ID) diagnosed by their treating neurologists; in one patient the ID was severe. In this case of severe ID, the questionnaire was developed together with and completed by the parents. The median CR in this sample was 93% (range: 31%–100%). Almost half of all patients (9 out of 20) completed at least 97% of all measurement points, that is, that up to 5 single questionnaires out of 180 measurement points were not completed. Six out of these nine patients did not miss any single measurement. Three patients stopped completing their questionnaire after a median of 57 measurements (range: 56–149).

Utilization of Treatment

During the considered treatment period of 6 months cooperative process-oriented treatment management yielded a median number of 11 scheduled sessions (range: 6–22). Closer examination revealed that seven participants (35%) received six to eight sessions that were at least 3 weeks apart, which corresponds to a low treatment frequency. Five participants (25%) received 9–12 sessions that were <3 weeks apart, which corresponds to a moderate treatment frequency; eight participants (40%) received 15–22 sessions that were <2 weeks apart, which corresponds to an intensive treatment frequency. Five participants missed altogether 11 sessions (range: 1–4 sessions). Three of these five participants had missed more than one session (range: 2–4 sessions). They had utilized an intensive treatment frequency with sessions that were <2 weeks apart and attended 80% of their sessions on average. Two of these three participants had been diagnosed with borderline personality disorder and comorbid PNES.

Quantitative Assessment of User-Friendliness and Usefulness

The overall satisfaction with the user-friendliness of the SNS was high (median VAS value 81.5, range: 23–100). In terms of usefulness of the SNS participants specified that the SNS facilitated new perspectives and insights into their experience and behavior (median VAS value 82.5, range: 20–99) as well as insights into one's own personal change process (median VAS value 80.5, range: 10–100). In regard to the integration of SNS in the therapeutic process

Table 2
Patient Characteristics

Patient characteristics	Total $n = 20$	
Gender (female) total (%)	15	(75%)
Age in years median [range]	48	[23–73]
Yrs since 1st seizure median [range]	18	[1–55]
Epilepsy diagnosis total (%)		
Focal epilepsy	17	(85%)
IGE	3	(15%)
Pharmacoresistant seizures	16	(80%)
AEDs total (%)		
None	2	(10%)
1 AED	6	(30%)
2 AEDs	10	(50%)
> 2 AEDs	2	(10%)
Comorbidities total (%)		
Comorbid PNES	3	(15%)
Adjustment disorder	3	(15%)
Mild depression	5	(25%)
Moderate depression	8	(40%)
Severe depression	2	(19%)
Anxiety disorder	12	(60%)
Borderline personality disorder	2	(10%)
Psychotropic medication total (%)		
Antidepressant medication	5	(25%)
Antipsychotic medication	2	(10%)

Note. AED = antiepileptic drug; IGE = idiopathic generalized epilepsy; PNES = psychogenic nonepileptic seizures; yrs = years.

participants indicated that that they were very satisfied with the discussions of time series graphs during psychotherapy sessions (median VAS value 92.5, range: 34–100) and the frequency and regularity of feedback sessions (median VAS value 83.5, range: 47–100), and that the application had positively influenced their relationship with the therapist (median VAS value 83.5, range: 47–100; see Table 3 for complete results).

Qualitative Assessment of User-Friendliness and Usefulness

Twelve patients (60%) left written responses to the feedback questionnaire's open questions. The following six main themes were identified: (a) facilitation of daily self-reflection; (b) understanding one's own psychological patterns and issues; (c) recognizing opportunities for change; (d) documentation of one's own development process; (e) motivation to enhance self-care and coping; and (f) challenges and reasons for discontinuation:

1. Facilitation of daily self-reflection

The daily completion of the questionnaire turned into a habitual part of the daily routine for some patients: "like taking my medication" (P1, CR: 99%, M) which they found "quick [and easy]" (P20, CR: 100%, M) and supportive of reflections on the past day "like keeping a diary" (P7, CR: 97%, H). The short reflections in the evening increased mindful self-perception during the day: "It contributes to paying attention to my everyday life and my behavior in some situations" (P19, CR: 100%, M).

2. Understanding one's own psychological patterns and issues

Qualitative analysis of comments revealed that participants appreciated the development of the personalized questionnaire which yielded a coherent and detailed conceptualization of their personal issues: "Now that I know what we are talking about, [I can talk [. . .] about my problems]" (P2, CR: 68%, L). Interrelations between items became clearer through the plotting of time series of different items in one graph and the joint reflection thereof (see Figures 4 and 5 as well as Supplemental Materials Figures S1 and S2 as examples). This "close and mindful look" (P5, CR 100%, M) increased self-knowledge and knowledge of one's condition.

Table 3
Ratings of User-Friendliness and Usefulness

Items	Median VAS rating	Range
1. How did you experience the daily completion of the questionnaire? VAS 0: *very badly* to 100: *very well*	58	15–90
2. How convinced was your therapist of the application of the SNS? VAS 0: *not convinced at all* to 100: *very convinced*	83	46–100
3. How satisfied were you with the application of the SNS? VAS 0: *very unsatisfied* to 100: *very satisfied*	81.5	23–100
4. How do you judge the user-friendliness of the application of the SNS? VAS 0: *very bad* to 100: *very good*	74.5	44–100
5. The application of the SNS influenced my relationship with my therapist ... VAS 0: *very negatively* to 100: *very positively*	83.5	47–100
6. The application of the SNS led me to a more intense examination of my issues and goals. VAS 0: *not at all* to 100: *very intensely*	80.5	23–100
7. The application of the SNS helped me to recognize my strengths and resources. VAS 0: *not at all* to 100: *very notably*	64	3–100
8. The application of the SNS helped me to better understand the correlation and context of different issues. VAS 0: *not at all* to 100: *very clearly*	78	24–100
9. The application of the SNS facilitated new perspectives and insights into my experience and behavior that I had not been aware of before. VAS 0: *not at all* to 100: *very clearly*	82.5	20–99
10. The application of the SNS helped me to better understand the relationship between my thoughts, feelings, and behavior. VAS 0: *not at all* to 100: *very notably*	80	20–99
11. The application of the SNS encouraged me to work on myself and my goals. VAS 0: *not at all* to 100: *very strongly*	78	12–99
12. The application of SNS facilitated new insights into my change process. VAS 0: *not at all* to 100: *very clearly*	80.5	10–100
13. Were you satisfied with the frequency and regularity of feedback discussions? VAS 0: *very unsatisfied* to 100: *very satisfied*	83.5	47–100
14. Were you satisfied with the content of feedback discussions? VAS 0: *very unsatisfied* to 100: *very satisfied*	92.5	34–100

Note. VAS = visual analogue scale; feedback discussions = discussions of time series graphs during psychotherapy sessions.

3. Recognizing opportunities for change

The investigation of the variables' interrelationships supported the identification of opportunities for change: "I believe that just by reflecting upon [the time series] new mental opportunities have opened up" (P17, CR: 100%, L).

4. Documentation of one's own development process

The detailed "visualizations of the ups and downs" of the patients' data entries made it "optically easy" to gain an overview over the ongoing personal development process (P20, CR: 100%, M).

5. Motivation to enhance self-care and coping

Many patients valued the initial insight into their own self-care resources facilitated by the SNS, "the understanding of the interrelationships enables me to better assess [what is positive and what is negative for me]" (P9, CR: 100%, H). Thereby, the application of the SNS supported participants in overcoming experiential avoidance of discomfort which in turn increased coping: "I have dealt with my condition and it made me less fearful" (P2, CR 68%, L).

6. Challenges and reasons for discontinuation

In some patients "a certain boredom set in" (P16, CR: 32%, M). One patient stated that the documentation of "absent change" could be "discouraging and frustrating" as it visualized one's own difficulty with implementing previously identified possibilities for change (P10, CR: 72%, H).

Correlating Number of Sessions and Feedback With Monitoring Compliance Rates

No notable correlations could be found between CRs of daily self-assessments and the number of scheduled treatment sessions nor between CRs and quantitative feedback on user-friendliness and usefulness; that is, all examined correlations were very weak and not significant (range of nonsignificant correlation coefficients across items: −0.10 to 0.18, see Supplemental Materials Table S3). Manual data review revealed indeed that both high and low CRs could be found in the group of participants with an intensive treatment frequency as well as in the group of participants with a low treatment frequency. In addition, both high and low CRs could be found in the group of participants who provided high feedback ratings on user-friendliness and usefulness as well as in the group of participants who provided low feedback ratings.

Illustrative Case Example

Figures 4 and 5 as well as Supplemental Materials Figures S1 and S2 show time series graphs of Mrs. C., a 30-year-old female patient with pharmacoresistant focal epilepsy, comorbid PNES, borderline personality disorder, and recurrent major depressive disorder. Mrs. C. had previously received inpatient psychiatric and neurological treatment. At the beginning of this outpatient psychotherapy intervention, she regularly attended neurological and psychiatric follow-up appointments. She had not complied with previous referrals to outpatient psychotherapy. In addition to antiseizure polypharmacotherapy and an antidepressant, Mrs C. received antipsychotic pharmacotherapy as she had started to hear female and male voices

approximately 1 year ago. These acoustic hallucinations expressed self-criticism and devaluation. Mrs. C. indicated that these hallucinations constituted the most bothersome symptom for her. Compared to the general population, the risk of psychosis is increased by almost eightfold in patients with epilepsy (Mula et al., 2021).

Mrs. C.'s ISM (Figure 1) highlighted the detrimental effect that "hearing voices" had on her level of "well-being," "exhaustion," "inner stress," and "anxiety." Furthermore, "hearing voices" led to decreased self-care such as "food intake" and "sleep." Remarkably, Ms. C. could not name any factors that amplified or decreased her acoustic hallucinations, and hence she felt very helpless in relation to this symptom. Mrs. C. agreed to the daily completion of a personalized process questionnaire informed by her ISM (see Supplemental Materials Table S1) even though she was very doubtful that such influential factors could be identified.

At the time of the preparation of this article, her individual time series comprised 231 data points (i.e., days) with only three missing data entries. Time series graphs were used during psychotherapy sessions and yielded the following meaningful insights and therapeutic decisions:

Figure 4 and Supplemental Materials Figures S1 and S2 show sections of time series graphs plotting the daily ratings of resource-oriented items that negatively correlate with the item "Today I heard voices":

- Figure 4. "Distracting myself" ($r = -0.51$)

- Supplemental Materials Figure S1: "Sleep quality" ($r = -0.50$)

- Supplemental Materials Figure S2: "Social interaction" ($r = -0.40$)

The joint review of these graphs gave rise to the hypothesis that these factors might alleviate acoustic hallucinations. Therefore, these graphs encouraged Mrs. C. to enhance the use of these identified resources. Consequentially, treatment sessions focused on the compilation of distracting activities, sleep hygiene, and social activation.

Figure 5 illustrates how treatment monitoring informed scheduling of treatment sessions through cooperative process-oriented management. As Mrs. C. continued to realize her personal treatment goals, that is, decreasing acoustic hallucinations and increasing her well-being, the frequency of scheduled sessions was tapered over time. At the moment of preparing this article, 23 treatment sessions had been scheduled; altogether Mrs. C. had missed five treatment sessions (22%).

Discussion

This uncontrolled feasibility study investigated high-frequency monitoring of personalized variables in patients with seizures in an outpatient neurology service. We particularly aimed at the evaluation of feedback on user-friendliness and usefulness of daily self-assessments. Contrary to our expectation, no notable correlations could be found between CRs of daily self-assessments and the number of scheduled treatment sessions nor between CRs and quantitative feedback on user-friendliness and usefulness.

A high median CR was found in this sample over a 6-month period (93%). Electronic data acquisition as part of treatment monitoring has previously been applied in very heterogeneous

Figure 4

*Covariation of Distraction and Acoustic Hallucination Over Time*
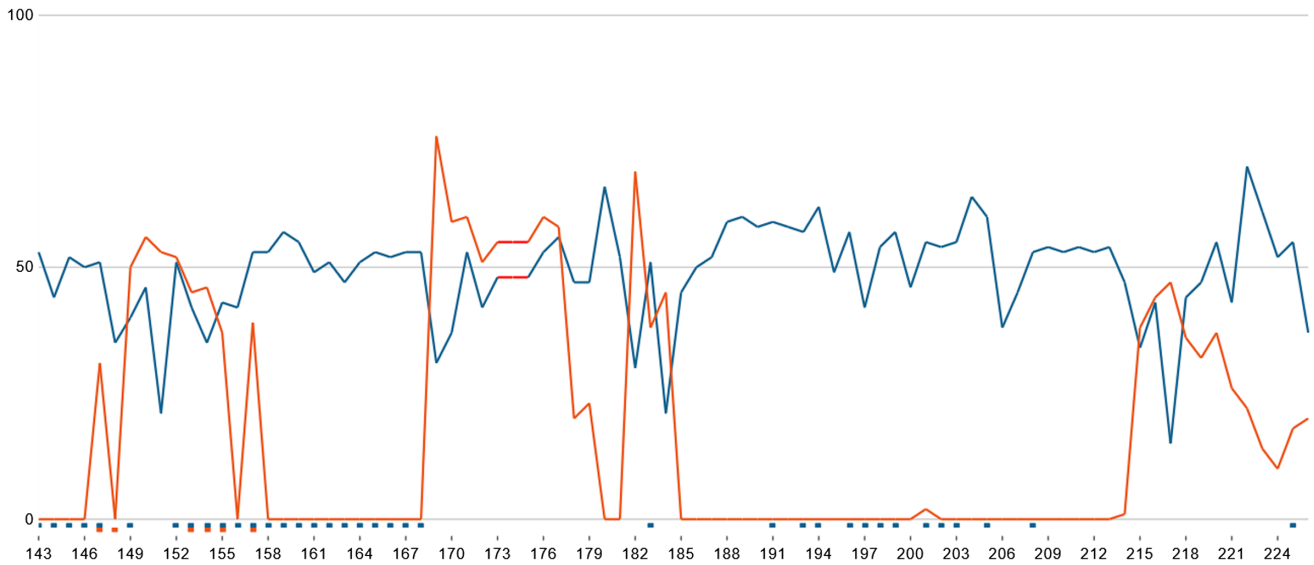
Note. Daily ratings of the items "Today I distracted myself" (blue line) and "Today I heard voices" (red line; *r* = −0.51); *Y*-axis indicates answers on a VAS (blue line—VAS 0: *not at all* to 100: *very much*; red line—VAS 0: VAS 0: *none* to 100: *very intensively*); *X*-axis indicates consecutive daily responses over time. See the online article for the color version of this figure.

patient populations including a wide range of psychiatric disorders found in a psychiatric day clinic where comparably high median CRs (89%) have been found over a 2- to 3-month period (Schiepek et al., 2016b). However, this is the first study that investigated

compliance with daily personalized monitoring in outpatients over a much longer time period. The high CRs in this study can likely be attributed to the personalization of the questionnaires' items and the high user-friendliness of web-based access specified by study

Figure 5

Treatment Utilization
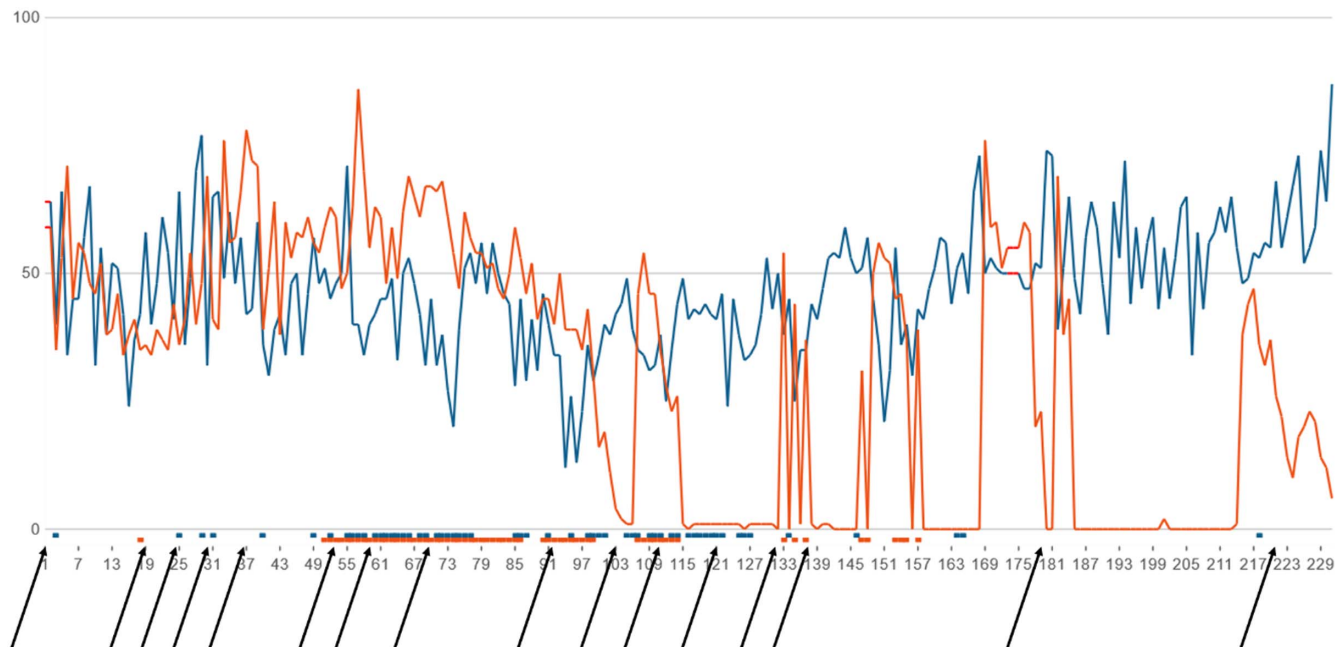
Note. Daily ratings of the items "Today I felt well" (blue line) and "Today I heard voices" (red line); *Y*-axis indicates answers on a VAS (blue line—VAS 0: *not at all* to 100: *very*; red line—VAS 0: *none* to 100: *very intensively*); *X*-axis indicates consecutive daily responses over time; arrows indicate treatment sessions attended by the patient. See the online article for the color version of this figure.

participants. In addition, participants indicated a high satisfaction with feedback sessions and session frequency informed by cooperative process management.

Participants in this feasibility study reported a high overall satisfaction with the user-friendliness and usefulness of high-frequency monitoring of personalized psychological variables. Participants most valued insight into connections between self-care behaviors and symptoms. For instance, visualizing the covariation of self-care behavior and symptom alleviation was quite reinforcing for the patient in the illustrative case example. This insight corrected the assumption of being helplessly at the mercy of acoustic hallucinations and increased motivation to consciously integrate self-care behaviors such as sleep hygiene and social activation into daily life. In addition, participants stated their high satisfaction with feedback sessions and that the application had positively influenced their relationship with the therapist which is in line with previous research indicating the meaningfulness of therapist–client agreement in psychotherapy (Chui et al., 2020).

Sessions in this study were not scheduled in order to comply with a predefined intervention's frequency but in agreement between therapist and patient by considering the individual therapy process. This cooperative process management yielded a large variability of scheduled sessions and high attendance with an overall low rate of missed sessions compared to other psychotherapy studies (Schiepek et al., 2015; Lazaratou et al., 2006). A recent interim analysis of outcome data collected during this study revealed that the number of treatment sessions was not related to the pretreatment scores of global distress, depression, and anxiety (Michaelis et al., 2021). This suggests that patient-related factors other than severity of psychopathological symptoms may have been critical in cooperatively determining session frequency.

Contrary to our expectation, the number of scheduled treatment sessions did not correlate with CRs of daily self-assessments. In fact, some patients with a low number of scheduled treatment sessions showed high compliance with treatment monitoring, suggesting that high-frequency treatment monitoring may be suitable for monitoring low-frequency treatment. Qualitative data review revealed that these participants appreciated the opportunity for daily self-reflection. In fact, time series informed by high-frequency monitoring may provide a comprehensive foundation for infrequent treatment sessions as they support the detection of meaningful events that occurred since the last treatment session whose discussion may therefore yield productive sessions (Correa et al., 2016). The patient in the illustrative case example showed a comparably high rate of missed appointments and a high compliance with treatment monitoring, suggesting that high-frequency treatment monitoring may even be suitable for monitoring treatment in patients with attendance issues such as patients with borderline personality disorder (Clarkin, 1996). This observation suggests that particularly digital treatment monitoring may introduce a new compliance measure complementing the compliance with the attendance of treatment sessions (Wierzbicki & Pekarik, 1993) or homework compliance (Primakoff et al., 1986).

Contrary to our expectations, the ratings of user-friendliness and usefulness did not correlate with CRs. The results actually suggest that even patients with lower CRs of daily self-assessments may find some elements of treatment monitoring beneficial. Qualitative data indicate that these patients may appreciate how the development of the personalized questionnaire informed by idiographic systems

modeling and questionnaire completion for a couple of months promoted insight whereas the regular completion of the same questionnaire for a longer period of time resulted in fatigue. These findings support the advantages of obtaining personalized process-related outcomes in psychotherapy (Barber & Solomonov, 2019; Desmet et al., 2021), which needs to be balanced with the possible disadvantages of repeated testing (Bos et al., 2015). However, future studies might consider the revision of questionnaires to address such fatigue. This revision could consist, for example, of updated items to reflect insights gained during the therapeutic process. One patient explained the discontinuation of daily monitoring with her dislike of the visualization of stagnation of her treatment process. However, such documentation may serve as a catalyst to explore noncompliance, reassess treatment goals as well as strategies (Gans & Counselman, 1996).

Limitations and Future Studies

Although this is the largest and longest personalized high-frequency monitoring study in patients with seizures and psychiatric comorbidity participating in outpatient psychotherapy, the small sample size of this feasibility study still constitutes the biggest limitation to a generalization of our findings. The nonconsecutive pragmatic sampling strategy applied in this feasibility study introduced the probable risk of selection bias. No notable correlations could be found between CRs of daily self-assessments and quantitative feedback on user-friendliness and usefulness and only 12 patients (60%) completed the open questions of the questionnaire. Thus, we cannot provide a comprehensive explanation of the relationship between participants' feedback and CRs. In addition, the participants' answers were processed by the therapist (RM) for analysis in the interprofessional team. Although the interprofessional team also had access to the complete original documents and the therapist's coding was critically reviewed, there is thus on the one hand a selective outcome reporting bias risk and a lack of blinding during the evaluation. On the other hand, it was a clear concern of the therapist to describe critical feedback on the SNS in order to question the extent to which she would like to continue working with the SNS and to improve her handling of the SNS.

The interim analysis of additional outcome data collected during this study indicated that responsiveness to therapy is not dependent on the number of attended treatment sessions (Michaelis et al., 2021). Ideally, subsequent analyses will help to investigate to what extent time series data correlate with pre- and postintervention outcome measures. These analyses may yield a method to compare responders with nonresponders to better understand and address mechanisms and precursors of nonresponsiveness to psychotherapy. The validity and explanatory power of this additional analysis should include an analysis of session content pertaining to the seizure-related treatment modules. In addition, we may generate hypotheses regarding efficient resource allocation to psychotherapeutic treatment.

Conclusions

High-frequency monitoring of psychological variables seems to be feasible to monitor and manage needs-oriented psychotherapeutic care in patients with seizures and psychiatric comorbidities. The results support the user-friendliness and usefulness of

high-frequency monitoring of outpatient psychotherapy and suggest that even patients with lower CRs may find some elements of treatment monitoring beneficial. Patients most valued insight into connections between self-care behaviors and symptom alleviation and indicated that the application had positively influenced their relationship with the therapist. The findings suggest that high-frequency monitoring may be suitable for monitoring of low-frequent treatment sessions and patients with attendance issues such as patients with borderline personality disorder.

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