Integrating ambulatory assessment data into clinical practice: Perspectives on interpretation and implementation

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Abstract

Objective: Naturalistic, personalized, ambulatory assessment (AA) data collected using smartphones or other health-tracking devices provides unparalleled opportunities for clinicians to assess symptoms, experiences, and therapy processes outside of session, ultimately strengthening the precision of clinical assessment and facilitating the delivery of increasingly personalized and adaptive (digital) interventions. However, there is relatively little clinician-friendly guidance to support the interpretation or implementation of AA data in psychotherapy. As clinical researchers and practicing psychologists, we aim to outline how AA data can be used collaboratively between clients and clinicians.

Method: We describe a case example involving the collection of self-reported AA data, then explain the challenges with interpreting and implementing AA data for clinical care.

Results: We discuss implementation-related barriers and provide recommendations for clinicians and those working in applied settings who are interested in integrating AA into their practice. For example, we recommend clinicians use a co-define client-centered variables and outcomes of interest, particularly a reporting period timeframe and a threshold at which change could be considered clinically meaningful.

Conclusion: We encourage the formation of research-practice partnerships between clinical researchers and clinicians to address barriers at the client-, clinician-, and clinic-levels of care to achieve effective and sustainable implementation.

Keywords: Ambulatory assessment; Experience sampling; Data literacy; Psychotherapy; Clinical practice; Implementation

Clinical and Methodological Significance of this Article

Ambulatory assessment (AA) data can help to improve the precision of clinical assessment and increase engagement in the psychotherapy process; however, there are several challenges a clinician might face in interpreting clinically relevant AA data for psychotherapy practice. We outline challenges, as well as potential solutions and strategies to facilitate the sustainable implementation of AA data in clinical settings, including the formation of research-practice partnerships to further investigate how AA can be used to strengthen psychotherapy practice and to address implementation-related barriers at the client-, clinician-, and clinic-levels of care.

Integrating ambulatory assessment into psychotherapy: Perspectives on interpretation and implementation

Ambulatory assessment (AA) refers to repeated measures data collected from smartphones or health-tracking devices (e.g., active watches), using methods known as experience sampling or ecological momentary assessment (Myin-Germeys et al., 2018; Trull & Ebner-Priemer, 2014). AA allows clinicians to measure clinically relevant constructs and psychotherapeutic processes outside of session, improving the temporal precision and ecological nature of assessment and increasing engagement in the psychotherapy process (Mestdagh & Dejonckheere, 2021; Reichert et al., 2021). By increasing the precision of assessment, clinicians are better equipped to adapt evidence-based interventions in session. Further, using AA data to develop a client-centered plan to maximize and maintain gains outside of session or following the close of treatment can help to increase client engagement in the psychotherapy process (see Table 1 for examples of practice-related benefits).

However, to date, there is little guidance *for clinicians* on how to collect, interpret, and implement AA output to inform psychotherapy practice. As clinical researchers and practicing psychologists ourselves, we aim to increase interdisciplinary crosstalk by outlining the challenges with collecting and interpreting AA data and identifying barriers for integrating AA into practice (see Table 2). We hope to inspire future research-practice partnerships to resolve these barriers and further investigate how AA can be used to support clients and clinicians beyond the traditional boundaries of the therapy room.

Challenges and perspectives on interpreting AA data

We begin our discussion with a motivating example of a clinician who wishes to use AA to understand factors that maintain their client's suicidal thoughts and behaviors (STB). The

client uses a smartphone app to complete brief self-report measures to track situational (e.g., daily stressors), affective (e.g., valence, intensity of specific emotions prior to and following an episode of STB), and cognitive factors (e.g., beliefs about STBs) each day between sessions of psychotherapy. At the beginning of a psychotherapy session, the clinician plots the client's AA data from the previous week and, together, they explore how the client- and clinician-identified trigger emotion of, 'shame' is linked to episodes of STB (Figure 1). Visual inspection of the AA output suggests that some, *but not all,* episodes of STBs are preceded by higher levels of shame and that shame decreases following some, *but not all,* episodes of STBs. Findings remain equally inconclusive when examining other tracked factors. So, what should be made of these inconclusive findings? The first – and perhaps only – fair interpretation is that shame and STBs are not related in an *easily* discernable way when measured using AA.

Integrating AA data into psychotherapy practice is challenging due to the tension between the rapid advancement of technology-based data collection methods and the relatively slower pace of psychometric research that is required for accurate analysis and effective interpretation of AA data (see Epskamp, 2019 for additional discussion). Researchers are responding to this tension with renewed discourse of psychometric issues related to the measurement and validity of constructs using AA (Bringmann & Eronen, 2018; Epskamp, 2019) and increased measurement-focused collaboration (see Maciejewski et al., 2023). However, there remains minimal discussion of how *clinicians* can address the psychometric or data literacy issues that complicate integration of AA into clinical practice. Resolving issues of data literacy (i.e., the "the ability to understand and use data effectively"; Frank et al., 2016) is critical for deriving accurate inferences from AA data and translating these inferences into actionable clinical

practice strategies (Mandinach & Gummer, 2013). We discuss three steps that clinicians can take to address issues of data literacy and improve the use of AA in psychotherapy practice.

Increasing precision in the measurement of AA constructs

Notably, patterns in AA data are a function of several design-related factors, such as the specific items chosen, the timescale of the reporting period, methods for tracking, and the techniques used to interpret change for specific individuals. To increase the precision in measurement of therapy-relevant constructs using AA, we recommend the clients and clinicians formulate AA variables together using a co-creation (e.g., *think-aloud*) process to define the construct as concretely as possible (Sales et al., 2023). Using the client's own words (e.g., "Feeling like I can't do anymore"), instead of adopting research or psychotherapy jargon (e.g., 'behavioral disengagement') ensures the client and clinician are aligned in the definition of the construct being measured (Soyster & Fisher, 2019). Greater alignment in construct definition can reduce the client's confusion when completing AA prompts, thereby increasing the accuracy in reporting and ease in interpreting output. Additionally, over the course of thoughtful discussion, the clinician can guide the client to identify which clinically-relevant factors are most aligned with the client's experience and update the AA assessment battery as new insights or information are gained in treatment (Scholten et al., 2022).

Increasing precision in the timeframe of assessment

Similarly, patterns in AA data likely differ depending on the timeframe of assessment. For example, the association between shame and STB likely differs depending on whether the AA reporting period spans the entire day or is constrained to the period immediately before an episode of STB (Hopwood et al., 2022). Alternatively, the association between shame and STBs may be time-varying; that is, the intensity of shame immediately before STBs prompts STB, but

only under certain conditions (e.g., when shame is above a certain [unspecified] threshold) (Fisher, 2023). Thus, to ease the use of AA data in clinical practice, we (clinical researchers) recommend that clients and clinicians clearly define the timeframe of the reporting period for a given AA construct. The timeframe of the reporting period may be determined based on published clinical research, data from other clients in the clinician's practice, or, most importantly, the client and clinician's estimation during co-creation processes (Burger et al., 2022). Furthermore, the timeframe of the reporting period can be updated based on new insights (i.e., lack of variability in collected data) or experiences observed during AA.

Increasing precision in the interpretation of change for specific individuals

The previous sections describe strategies to increase the precision in the measurement of clinically relevant constructs using AA. However, even if constructs were defined measured with perfect precision and accuracy, the techniques used to measure and interpret clinically meaningful change, particularly on the individual-level, remain limited (Helmich, 2024; Piccirillo & Rodebaugh, 2019). That is, clinical researchers do not yet fully understand the implications of various dynamic patterns as measured using AA (Helmich et al., 2021), much less how these dynamic patterns relate to meaningful change for *specific individuals* (Hamaker, 2012). For example, although stable levels of depressed mood may signal transition into a depressive episode for individuals on average (van de Leemput et al., 2014; Wichers & Groot, 2016), the implications of these signals for specific individuals is unclear (Dablander et al., 2022; Helmich et al., 2021; Tonge et al., 2024). Thus, we encourage clients and clinicians to collaboratively determine the threshold that corresponds to therapy goals or outcomes to define the point at which meaningful change is likely to occur. We also encourage clinicians to

collaborate with clinical researchers working to develop, validate, and disseminate techniques for tracking and interpreting reliable change for specific individuals (Helmich, 2024).

Overall, interpretating AA data to guide psychotherapy practice is constrained by our limited understanding of best practices for measuring clinically relevant constructs and interpreting meaningful using AA. To support clinicians interested in integrating AA in their practice, we call on clinical researchers to develop and promote freely or easily accessible resources to improve data literacy (e.g., "School of Data", "The Open Data Institute", "Harvard Data Wise") and to integrate data literacy training into clinical training programs. Likewise, we call on clinicians to pursue such trainings and to disseminate lessons learned with their colleagues and trainees (e.g., via onboarding or continuing education).

Challenges to implementing AA data into clinical practice

Challenges to *interpreting* AA data for clinical practice discussed above and challenges to *implementing* AA data into clinical practice are interconnected yet distinct. Specifically, the success of implementation is dependent on several aspects linked to the interpretation of AA data, such as the acceptability of collecting AA data in clinical settings, the appropriateness of tracking symptoms and experiences using AA, and the feasibility of strategies to improve integration of AA into clinical practice. Understanding the impact of implementation-related factors at multiple levels within healthcare settings can aid in resolving these challenges more effectively (Kirchner et al., 2020). We outline implementation-related challenges that limit the integration of AA data into clinical practice below and in Table 2.

Client-level implementation: Addressing reluctance

In our experience, clinicians have expressed concern on behalf of their clients around the iatrogenic potential of repeated assessment (known to clinical researchers as 'measurement

reactivity'; French & Sutton, 2010). However, available empirical data indicate minimal iatrogenic response to AA (see Coppersmith et al., 2023) and suggest clients are generally receptive to AA tracking (Frumkin et al., 2021; Simons et al., 2015). Indeed, among clinical researchers there is increasing recognition that AA is not 'just' an assessment method (Gass et al., 2021), but may also function as an interventional process to facilitate therapeutic change via increased awareness (e.g., similar to tracking symptoms using a diary card in dialectical behavior therapy; Linehan, 1993). Thus, to improve implementation at the client-level, we call on clinical researchers to conduct (qualitative) research to more thoroughly characterize the nature of client-relevant concerns, specifically the perspectives of clients who are hesitant or unwilling to complete AA. Furthermore, we encourage clinicians to leverage the client's natural interest or motivation for AA and to balance optimism for AA with open discussion of the potential consequences, making decisions regarding the administration of AA on a client-by-client basis.

Clinician-level implementation: Dealing with practical barriers

Although research demonstrates that repeated outcomes monitoring (a proto-modality of AA) improves clinical practice (Barkham et al., 2023; Lambert et al., 2018), clinicians often report practical barriers with repeated outcomes monitoring, including limited time, training, and interest in learning and implementing new technologies. Thus, improving implementation of AA at the clinician level first requires easing the practical limitations of using AA in clinical practice by leveraging the identified 'value-add' (Hall et al., 2024; Piccirillo et al., 2022). We encourage the formation of research-practice partnerships to improve strategies for integrating AA into clinical care. Researchers could benefit from collaboration with practitioners who are hesitant to implement AA protocols in their clinical care and conduct quality improvement or program evaluations aimed at identifying and addressing implementation barriers. However, for research-

practice partnerships to maximally benefit the field, results from this work must be easily shared using freely accessible platforms (e.g., open access, clinically focused journals).

Clinic or systems-level implementation challenges

Finally, successful implementation of AA into clinical practice requires identifying and addressing barriers at the clinic- or systems-level, adapting AA to meet clinic-specific or broader societal-norms regarding the use of technology in clinical practice (Scholten et al., 2024). Thus, we encourage the continuation of research examining various cultural adaptations of AA to improve global implementation (Heim & Kohrt, 2019). Furthermore, we encourage clinical leadership to pursue the use of innovative tools and strategies that help ease the collection and interpretation of AA data for clinical practice. For example, clinics could partner with industry collaborators to offer clinician-friendly technology-based platforms for collecting and visualizing AA data. However, successful clinic-industry partnerships requires explicit discussion of financial costs (e.g., as outlined in a business plan Osterwalder & Pigneur, 2010). Furthermore, increasing the scale of AA in psychotherapy practice will likely involve contracting with (or renegotiating) with insurance companies to cover the costs and labor involved with collecting AA data for clinical practice. Overall, the key to successful, long-term implementation is to initiate and maintain collaborations *across* all levels of a healthcare system and to view implementation as an evolving process sustained through repeated trainings, educational materials and meetings, reminders, auditing, and feedback (Damschroder et al., 2022; Pereira et al., 2022).

Conclusion

As practicing research psychologists conducting clinical research on the use of technology to improve clinical care, we believe the field is only just beginning to realize the

potential for AA to improve the precision of clinical assessment and to strengthen engagement in the psychotherapy process through the design of more personalized, adaptive, and accessible interventions. We hope this paper serves as a launch point to encourage progressive, innovative clinicians and clinical researchers to engage in collaborative research to investigate AA's potential to strengthen psychotherapy practice.

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Table 1

Examples of AA data and benefits for clinical practice

Example of AA data or output	Benefits to clinical practice
Passively collected health-tracking data	Provides real-time, objective, naturalistic data to contextualize a client's symptoms or experiences outside of session
Brief self-reports of clinically relevant outcome measures (e.g., daily situations and behaviors)	Co-creation and tracking of clinically relevant variables may increase engagement in the psychotherapy process, benefiting the clinician by increasing the precision in measurement of clinically relevant constructs and benefiting the client by increasing self-awareness in real-time
Graphical visualizations of AA output	Plotting clinically relevant variables as they occur and change outside of session can guide clinical decision-making (e.g., additional assessment, alternative interventions)
Just-in-time adaptive interventions that deliver clinical strategies following the real-time report of personalized triggers to prevent engagement in maladaptive behaviors and to mitigate increased distress	AA data collected using smartphones can be used to guide real-time clinical assessment or the delivery of momentary interventions, providing therapeutic support with greater proximity to clinically relevant outcomes.

Table 2

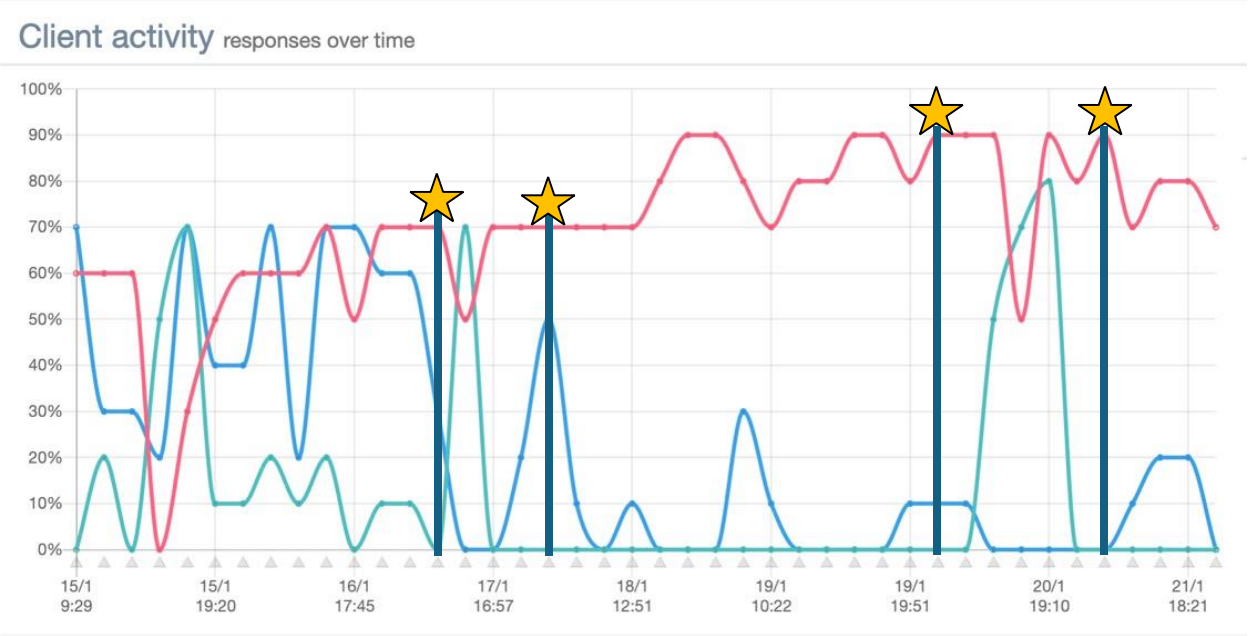
Facilitating crosstalk: Integrating clinical researcher and clinician perspectives

Issues	Clinical researchers' contributions	Clinicians' contribution
Interpreting AA data for clinical practice	• Design trainings to introduce clinicians to AA data and guide their use of AA (output) in clinical practice • Disseminate data literacy resources • Design and disseminate methods for interpreting reliable and clinically meaningful change using AA data • Integrate data literacy education (particularly, as relevant to AA data) into clinical training programs	• Work with clients using a co-creation process to formulate and define AA constructs, including the timeframe of assessment, and the threshold at which clinically meaningful change is likely to occur • Partner with clinical researchers developing methods for measuring reliable and clinically meaningful change using AA data • Pursue training in data literacy as relevant to AA data • Disseminate information from trainings on AA literacy with other clinicians and trainees (e.g., via onboarding or continuing education)
Client-level challenges to implementation	• Conduct research to understand reactivity to AA protocols • Evaluate preferences and concerns of clients completing AA (e.g., using qualitative research) • Continue research examining the construct validity of variables measured using passive sensing	• Talk openly with clients about the benefits, consequences, and experiences of completing AA • Evaluate decisions regarding administration of an AA protocol on a client- by client- basis
Clinician-level challenges to implementation	• Evaluate preferences and concerns of clinicians using AA in clinical practice	• Maintain curiosity and openness towards the integration of AA data in clinical practice

	• Conduct quality improvement research to identify and address clinician-level barriers • Publish scientific findings in open, accessible venues (clinically focused journals, clinician blogs/groups, open science platforms)	• Engage in interdisciplinary, participatory research to increase awareness of clinician-level barriers
Clinic-level challenges to implementation	• Examine the feasibility and accessibility of AA protocols in non-Western samples to inform cultural adaptations of AA • Pursue interdisciplinary collaborations to develop novel solutions to reduce clinician burden • Conduct quality improvement research to identify and address clinic-level barriers • Publish research results in open, accessible venues (clinically focused journals, clinician blogs/groups, open science platforms)	• Participate in interdisciplinary collaborations to increase awareness of clinic-level barriers

Figure 1

Descriptive plot of AA data reported on by an exemplar client



Note. This graph shows AA data collected six times per day over the course of a week from an exemplar client. Variables included, “I felt ashamed” (red line), “I felt listless” (blue line), “I thought I can’t do anymore” (green line). Response option ranged from 0% (*Not at all*) to 100% (*Very much*). Yellow stars indicate self-reported episodes of suicidal thoughts and behaviors.