



Editorial

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Digital mental health: innovations in assessment and intervention

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Depression and anxiety together are ranked among the leading causes of disability, affecting hundreds of millions of individuals worldwide (GBD 2019 Mental Disorders Collaborators, 2022). Yet, psychiatric care faces persistent structural barriers: limited specialist availability, geographic inequities, diagnostic subjectivity, and the stigma that deters help-seeking behaviors (Patel et al., 2018). Digital technologies, including mobile health platforms, internet-delivered interventions, and artificial intelligence (AI)-driven analytic tools, are beginning to address these constraints by extending the reach and scalability of mental health services (Graham et al., 2019; Torous et al., 2021). This transition was accelerated by the coronavirus disease 2019 (COVID-19) pandemic, as clinicians worldwide adopted remote assessment and teletherapy out of necessity (Wind et al., 2020). The promise of these tools, however, goes beyond crisis response: it not only enables population-level screening but also provides new forms of therapeutic engagement and the discovery of objective diagnostic biomarkers.

This special column titled “Digital Mental Health: Innovations in Assessment and Intervention” in *Journal of Zhejiang University-SCIENCE B* brings together three investigations that span this field from assessment to diagnosis. Luo et al. (2026) report a nationwide smartphone-based cognitive screening of COVID-19 survivors. Meanwhile, Zhou et al. (2026) offer a systematic appraisal of therapeutic alliance (TA) formation across face-to-face (FTF), pure online (PO),

and blended (BLD) psychotherapy. Du et al. (2026) present a vision-language AI framework that reconstructs three-dimensional (3D) facial emotion dynamics to distinguish bipolar disorder (BD) from major depressive disorder (MDD). These studies address three questions at the heart of digital psychiatry: (1) Can digital tools reliably assess cognitive function at the population scale? (2) Does the conventional therapeutic relationship survive the transition to digital media? (3) Can AI extract clinically useful biomarkers from routine clinical recordings?

Digital cognitive assessment at the population scale

While the cognitive sequelae of COVID-19 have become a major public health concern, large-scale assessments in the immediate aftermath of mass infection events have been burdened by major practical challenges. Herein, Luo et al. (2026) report the first nationwide smartphone-based cognitive assessment conducted in the Chinese population during the sub-acute phase (<3 months) of COVID-19 following the relaxation of pandemic control measures in December 2022. Using the Integrated Cognitive Assessment (ICA) and the Number Ordering Test (NOT), as two validated online neuropsychological instruments, they evaluated 9663 participants across all 31 provinces of mainland China, of whom 8905 (92.2%) were COVID-19 survivors infected with the Omicron variant.

Their findings reveal a notable dissociation between subjective experience and objective performance. Over 65% of survivors reported inflexible thinking, 61% noted slowed information processing speed, and 49% experienced insomnia after initial

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recovery. Nevertheless, after adjusting for socio-demographic covariates, the only significant objective cognitive difference between survivors and uninfected individuals was a subtle reduction in ICA accuracy (reflecting semantic processing), with negligible effect sizes (partial $\eta^2 \leq 0.001$). This discordance is consistent with the findings of the large Real-Time Assessment of Community Transmission-2 (REACT-2) study in England (Hampshire et al., 2024), which similarly reported modest objective deficits despite widespread subjective complaints among Omicron-infected individuals.

Insomnia was identified as the strongest and most consistent modifiable risk factor for poorer cognitive performance across all assessed domains, surpassing even subjective cognitive complaints in predictive strength. This finding has direct clinical implications: evidence-based sleep interventions, including cognitive behavioral therapy for insomnia, may be a high-yield target for mitigating post-COVID cognitive morbidity (Hampshire et al., 2024; Zeraatkar et al., 2024). Female sex, older age, low education level, and residence in Northwest China were also independently associated with poorer cognitive outcomes; hence, these subgroups warrant prioritized monitoring.

This work demonstrates the feasibility of smartphone-based cognitive screening for rapid, population-level deployment during public health emergencies. This approach overcomes the limitations of traditional paper-and-pencil assessments that require substantial personnel and are insensitive to mild impairment (Diana et al., 2023) and provides a scalable model for future pandemic preparedness.

Therapeutic alliance in the era of digital psychotherapy

The accelerated adoption of online and blended psychotherapy has raised a fundamental question: can the TA, widely recognized as one of the most reliable predictors of psychotherapy outcomes (Flückiger et al., 2018), be established and maintained when therapist and patient are separated by a screen? Zhou et al. (2026) address this question through a systematic narrative review based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses/Synthesis Without Meta-analysis (PRISMA/SWiM) framework. They present synthesized evidence from nine studies

(three primary randomized controlled trials and six secondary analyses) comparing TA across FTF, PO, and BLD psychotherapy formats in adults with depressive or anxiety disorders.

The principal finding is reassuring: TA strength was broadly comparable across all three delivery modalities. This equivalence held regardless of whether the online component was synchronous (videoconference or telephone) or asynchronous (therapist-guided digital interventions). One exception was a transient lag in early alliance formation: patients receiving asynchronous online therapy reported significantly lower working alliance inventory (WAI) scores at Week 2 compared to FTF controls, whereas this difference resolved by Week 8, suggesting that patients acclimate to the digital therapeutic environment over time.

More nuanced findings emerged regarding the TA–outcome association. While patient-rated alliance reliably predicted clinical improvement in FTF settings, this relationship was less consistent in online and blended formats. In certain PO studies, only therapist-rated alliance predicted symptom reduction, potentially because therapists in remote settings have greater access to behavioral engagement indicators such as task completion and messaging patterns. The authors propose that digital delivery may shift the functional emphasis of the alliance from affective bonding toward task and goal engagement, a rebalancing that could have implications for therapist training and platform design.

The review also points to a potential advantage of blended formats in that they combine the interpersonal depth of initial FTF contact with the structural efficiency of online modules. This configuration may offer an effective compromise, anchoring the relationship through early in-person rapport while using digital tools for sustained engagement. As psychotherapy evolves in the post-pandemic era, these findings point to the need for digital-specific TA measurement tools and prospective studies that may be able to disentangle the causal mechanisms through which alliance operates across communication media.

AI-driven objective biomarkers for psychiatric differential diagnosis

The differential diagnosis between MDD and BD remains one of the most difficult clinical decisions in

psychiatry, with misdiagnosis rates estimated at 20% or higher (Chen et al., 2024). Inappropriate antidepressant monotherapy in unrecognized BD can trigger manic switches and worsen disease trajectories, making objective diagnostic aids a clinical priority (Singh et al., 2025). Du et al. (2026) tackle this challenge by combining computer vision, natural language processing, and clinical psychiatry.

In their proposed framework, an adaptive-shape vision-to-language model (AsmV2L) capability advances 3D face reconstruction from monocular clinical videos. The key innovation is a fine-grained textual semantic chunking mechanism that achieves precise binding between language descriptions and local facial parameters, combined with an adaptive weighted loss function that strengthens geometric constraints on expression-sensitive regions such as the periorbital and perioral areas. This design enables the high-fidelity reconstruction of subtle and extreme facial expressions that are critical for psychiatric affect analysis.

Applied to a clinical dataset of 262 patients (130 with BD and 132 with MDD) collected at The First Affiliated Hospital of Zhejiang University School of Medicine over 19 months, AsmV2L extracted valence-arousal (VA) dynamics that revealed distinct affective signatures for the two disorders. BD patients exhibited “emotional instability” characterized by pronounced fluctuations between positive and negative states, whereas MDD patients showed “emotional blunting” with persistently reduced affective reactivity even under positive emotional stimulation. Under the happy condition, BD patients demonstrated higher valence (0.411 ± 0.089 vs. 0.316 ± 0.096) and arousal (0.423 ± 0.092 vs. 0.322 ± 0.098) compared to MDD patients, while under the sad condition, BD patients showed more extreme negative valence (-0.326 ± 0.067 vs. -0.253 ± 0.076). These quantitative emotional dynamics align with established clinical observations of the two disorders (Fagiolini et al., 2021; Steardo et al., 2025) and provide an objective, reproducible metric framework for differential characterization.

In subject-level 5-fold cross-validation, the emotional dynamic features achieved an accuracy of 88.9% and an area under the receiver operating characteristic (ROC) curve (AUC) of 0.940 in distinguishing BD from MDD, outperforming both two-dimensional (2D) affect-feature baselines and the emotion-driven monocular face capture and animation (EMOCA) framework.

AsmV2L achieved superior sensitivity (the ability to correctly identify BD cases), which is clinically important given the consequences of missed BD diagnoses. On public benchmarks, AsmV2L maintained competitive 3D reconstruction accuracy while achieving superior emotion recognition performance; hence, its clinical gains do not come at the expense of geometric fidelity.

This work is part of a broader effort to use AI and multimodal data for psychiatric biomarker discovery (Sadeghi et al., 2024). While validation in larger multi-center cohorts is essential before clinical deployment, the non-invasive, low-cost nature of video-based analysis makes this a promising auxiliary tool for community-level psychiatric screening.

Summary and future perspectives

The three studies included in this special column outline the contours of digitally informed mental health care. They demonstrate that (1) smartphone-based cognitive assessment can be deployed at scale to monitor population-level cognitive health in real time; (2) the TA, a well-established predictor of psychotherapy outcomes, is resilient to digital delivery, although its mechanisms may be reconfigured in online environments; and (3) AI-driven facial analysis suggests that objective emotional biomarkers can be extracted, which may offer promising diagnostic potential even for highly challenging psychiatric differential diagnoses.

Several themes recur across these contributions. First, the importance of validation in diverse, real-world populations is clear. Each study acknowledges the need for multi-center replication: Luo et al. (2026) recognize the potential sampling bias of their WeChat-based snowball recruitment; Zhou et al. (2026) note the predominance of short-to-medium-term cognitive behavioral therapy trials in Western samples; and Du et al. (2026) highlight the single-center limitation of their clinical dataset. Second, these studies illustrate the tension between technological capability and clinical interpretability. As AI systems become more sophisticated, it remains a priority to ensure that their outputs are transparent, explainable, and actionable for clinicians. Third, as these tools move toward clinical implementation, ethical considerations including data privacy, algorithmic bias, digital literacy disparities,

and the appropriate role of technology in the therapeutic relationship must be addressed (Torous et al., 2021).

Several directions for future work deserve attention. The integration of multimodal data streams combining facial dynamics, speech patterns, physiological signals, and digital behavioral markers may yield more complete psychiatric phenotyping than any single modality alone. The development of digital-native TA measures, specifically validated for online and blended care, can strengthen the evidence base for technology-mediated psychotherapy. Adaptive, closed-loop intervention systems that dynamically adjust therapeutic content based on real-time cognitive and affective monitoring could personalize treatment delivery to a degree that is currently impractical to implement. Finally, combining population-scale digital assessment with AI-driven diagnostic tools could make psychiatric care more accessible, scalable, and precise than current models allow.

We hope that this collection of works will encourage collaboration between computer scientists, clinical researchers, and mental health practitioners. The shared goal remains clear: reducing the global burden of mental disorders through well-designed technology.

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Author contributions

Shaohua HU conceptualized the special issue. Hailong LYU and Shaohua HU led the drafting of this editorial. Zhaojie JU and Jianzhong YANG contributed to the writing and critical revision. All authors have read and approved the final manuscript.

Compliance with ethics guidelines

Hailong LYU, Zhaojie JU, Jianzhong YANG, and Shaohua HU declare that they have no conflicts of interest.

This editorial does not contain any studies with human participants or animals performed by any of the authors.

Declaration on the use of generative AI tools

During the preparation of this editorial, the authors used Claude (Anthropic) to assist with language refinement. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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