Digital Doula Interventions for Perinatal Mental Health: Integrating AI and Remote Support in Neuropsychiatric Care

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Abstract

Perinatal mental health disorders, including anxiety, depression, and post-traumatic stress following childbirth, represent significant neuropsychiatric challenges affecting maternal and infant well-being. Traditional doula support has shown measurable benefits in reducing psychological distress and improving emotional outcomes during childbirth. Recent advancements in digital health have introduced the concept of *digital doulas*-AI-enhanced, telehealth, or mobile-based systems designed to provide continuous emotional and informational support to birthing individuals. This review synthesizes current evidence on digital doula interventions and their impact on perinatal mental health through the lens of neuropsychiatry. We examine how emerging technologies-such as artificial intelligence, digital biomarkers, predictive modeling, and tele-neuropsychiatry-can extend the reach and precision of doula care. Furthermore, we discuss the neuropsychiatric mechanisms underlying digital emotional support, including stress regulation, oxytocin-mediated bonding, and neural plasticity, alongside ethical and cultural considerations in deploying AI-driven maternal support systems. By integrating neuroscience, psychiatry, and digital innovation, digital doula interventions offer a promising frontier for precision mental healthcare in perinatal populations.

Keywords

Digital Doula, Perinatal Mental Health, Artificial Intelligence, Tele-Neuropsychiatry, Precision Psychiatry

1. Introduction

Perinatal mental health disorders-including antenatal and postnatal depression, anxiety, and childbirth-related trauma-constitute a major public health concern, with substantial implications for both maternal and infant neurodevelopmental outcomes. Traditional psychosocial support models, such as the provision of birth doulas, have shown beneficial effects on maternal emotional well-being and birth experience, yet their scalability remains limited by resource constraints and geographical disparities. Recent advances in digital health have created new opportunities to extend and personalise maternal support: digital platforms, mobile applications, chatbots and telehealth services now offer the potential for continuous, remote intervention. Indeed, a recent systematic review found that telemedicine interventions for pregnant women or new mothers achieved significantly improved mental-health outcomes in 62% of included studies [1]. In a large retrospective study of a digital prenatal platform, utilisation was associated with better management of depression and anxiety among peripartum persons [2].

Within the intersection of maternal care, mental health and technology, the concept of a “digital doula” emerges: a digitally mediated system-potentially incorporating artificial intelligence, remote monitoring and patient-centred digital therapeutics-that mimics or augments the emotional, educational and advocacy functions of a traditional doula. Although the role of human doulas in supporting perinatal mental health has been investigated, digital extensions of this model remain underexplored in neuropsychiatric research [3]. Moreover, emerging work suggests that AI-enabled mental-health apps in the perinatal period may reduce depressive symptoms and safeguard privacy, pointing toward the feasibility of intelligent digital support systems [4].

Despite these technological advances, several critical gaps remain. First, little attention has been given to the underlying neuropsychiatric mechanisms through which digital doula interventions might exert beneficial effects-such as modulation of stress-regulation circuits or neuroplastic adaptation. Second, issues relating to algorithmic bias, data privacy, digital health equity and integration into standard perinatal care pathways demand rigorous scrutiny. Third, evidence on how digital doula interventions can be scaled and personalised-leveraging digital biomarkers, predictive modelling and machine learning-remains nascent. Together, these considerations call for an interdisciplinary synthesis of neuroscience, psychiatry, engineering and maternal–child health.

In this article, we provide a comprehensive review of digital doula interventions aimed at perinatal mental health, examining the evidence base, technological enablers (including AI and remote monitoring), neuropsychiatric

mechanisms of action, and ethical/regulatory implications-with the ultimate goal of advancing precision mental-health care in the perinatal period.

2. Conceptual Framework: From Traditional to Digital Doulas

The model of doula-led support has its roots in the traditional birth care system, where a doula-defined as a trained non-clinical companion offering continuous physical, emotional and informational support during labour and the postpartum period-has been associated with improved maternal outcomes such as reduced anxiety, enhanced childbirth satisfaction and increased breastfeeding initiation. For example, a recent review observed that doula-supported care was linked to lower rates of preterm birth and low birth-weight, and was especially beneficial in reducing disparities among Black birthing individuals [5].

Beyond obstetric outcomes, qualitative inquiry has demonstrated that doulas play an active role in supporting perinatal mental health through rapport-building, culturally-congruent care, and facilitating access to psychosocial resources [3].

Yet while traditional doula care offers rich interpersonal support, its scalability is constrained by workforce shortages, geographic barriers, and variation in training and scope. In parallel, the perinatal period continues to present high risk for mood and anxiety disorders: meta-analytic evidence indicates a prevalence on the order of one quarter in low- and middle-income countries [6]. These contextual pressures invite the consideration of digital augmentation of doula services.

The transition to “digital doulas” can be conceptualised as the layering of remote, technology-mediated support onto the foundational functions of the traditional doula. In this framework: (i) Emotional support is extended via tele-doula sessions, chatbots, mobile apps or remote peer networks. (ii) Informational support is delivered through digital platforms that provide tailored guidance (e.g., childbirth preparation, coping with anxiety) leveraging user data and AI-driven personalisation. (iii) Continuous monitoring and timely intervention become feasible through digital biomarkers (e.g., self-reported mood, wearable heart-rate variability) and predictive analytics. Crucially, this framework positions digital doula interventions at the intersection of perinatal care, neuropsychiatry and digital health innovation.

Key elements of the framework include: (i) Human-informed base-the doula’s role remains centred on presence, advocacy and emotional attunement. (ii) Technological enhancement--tools such as AI chatbots, machine-learning risk stratification, remote multimedia education amplify reach and personalise engagement. (iii) Neuropsychiatric orientation-the support is no longer merely psychosocial, but informed by digital biomarkers, stress regulation systems, and brain-behaviour pathways. (iv) Scalability and accessibility-by leveraging remote technology, support can transcend geographical and resource constraints, enabling broader reach and potentially reducing disparities. (v) Feedback loop and adaptation - user-data (behavioural, physiological, self-report) feed into adaptive algorithms to refine support pathways, enabling precision mental-health interventions. In light of this framework, the remainder of this review examines (i) the empirical evidence for digital doula-type interventions in perinatal mental health, (ii) the enabling technologies and digital biomarkers, (iii) underlying neuropsychiatric mechanisms and (iv) ethical/regulatory implications of deployment in real-world settings.

3. Evidence on Digital Doula Interventions for Perinatal Mental Health

Emerging evidence indicates that digitally mediated perinatal support interventions can meaningfully reduce maternal psychological distress, although few studies to date have specifically labelled the intervention "digital doula". One recent meta-analysis of 63 randomized controlled trials found that digital health interventions (DHIs) significantly alleviated perinatal fear (SMD=-1.90), anxiety (SMD=-0.84), and depressive symptoms (SMD=-0.54) [7]. A systematic review of 12 intervention studies published in 2024 concluded that internet-based cognitive behavioural therapy and mindfulness were the predominant approaches and that partner-inclusion was rarely addressed [8].

Programs that are closer to the “doula-type” model-i.e., continuous emotional/informational support delivered via a digital platform-are beginning to show promise. For example, a mixed-methods study investigating perinatal women’s engagement with a digital emotional-well-being training found high user acceptability and reported reduction in distress symptoms [9]. Moreover, the use of a virtual doula within a digital health platform was associated with increased odds of reporting emotional support and managing mental health during pregnancy (aOR 1.78, 95% CI 1.40-2.26) in a sample of 8,989 users [10].

Beyond outcome effects, the literature highlights critical design characteristics and gaps. Peer-support combined with mobile health was associated with decreased depressive scores and high satisfaction among perinatal women [11]. However, usability, user-engagement, attrition and the detail of digital platform features remain under-reported (e.g., a scoping review of digital behavioural activation interventions emphasized low adherence and poor reporting of digital delivery) [12].

4. Digital Technologies Enabling Doula Support

The conceptual transition from traditional doula care to digital doula interventions is underpinned by a suite of emerging technologies that enable scalable, responsive, and personalised perinatal mental-health support. In the context of perinatal care, three key technological domains are particularly salient: (i) artificial intelligence and machine learning

for personalised prediction and support; (ii) digital biomarkers and real-time monitoring for mood/stress regulation; and (iii) telehealth and mobile platforms for remote delivery and continuous engagement.

4.1 Artificial Intelligence & Machine Learning

AI and machine-learning algorithms are increasingly being used in mental health care for risk stratification, monitoring, and intervention delivery. For example, a systematic review found AI tools (e.g., SVM, random forest, chatbots) demonstrated accuracy in diagnosing and monitoring mental-health conditions, though gaps remain in interpretability and clinical deployment [13]. Within the perinatal context, preliminary work indicates that machine-learning models can improve prediction of postpartum depression risk compared to conventional screening approaches - though the evidence base remains limited [4]. In the digital doula framework, AI enables two critical functionalities: real-time personalisation of support (e.g., selecting content or emotional-support prompts based on the user's data) and automated risk alerts (e.g., detecting elevated stress or mood decline and triggering human doula involvement). The integration of AI therefore transforms the support model from reactive to proactive and adaptive.

4.2 Digital Biomarkers & Predictive Monitoring

A central advantage of digital platforms is the ability to collect and analyse continuous streams of user data (self-report, wearable sensors, app engagement metrics) to derive digital biomarkers relevant to emotional regulation and stress response. For example, digital mindfulness-based interventions during pregnancy were shown to reduce depressive and anxiety symptoms (effect sizes −0.47 and −0.41 respectively) in a meta-analysis of 13 studies [4]. Similarly, a scoping review of digital behavioural activation interventions reported limited adherence, poor reporting of platform features, and sparse usage of biomarker data (e.g., HRV, sleep metrics) in perinatal settings [14]. For digital doula systems, embedding biomarker-based feedback loops offers the possibility of tailoring support intensity, mode (chatbot vs. live doula), and timing (e.g., in response to elevated physiological stress)-thereby aligning with the precision-neuropsychiatry paradigm emphasised by the target journal.

4.3 Tele-neuropsychiatry & Remote Platforms

Remote delivery of doula-type support via telehealth, mobile apps or online communities extends access beyond geographical and resource barriers. A recent systematic review of digital interventions for perinatal depression and anxiety reported that while many programmes exist (internet-CBT, mindfulness), few included partner participation or full doula-style continuous support models [8]. In the digital doula framework, remote platforms serve three functions: (1) on-demand access to emotional/informational support (e.g., live chat with doula or chatbot); (2) scheduled check-ins (e.g., video call before labour, postpartum follow-up); (3) community/peer networks moderated digitally, complementing the doula's role. By enabling continuous, asynchronous support, these technologies help address the "24/7" need that traditional in-person services cannot scale.

4.4 Integration & Interoperability Considerations

To operationalise digital doula systems, interoperability with existing electronic health-record systems, wearable devices, and telehealth platforms is essential. Moreover, user-experience design (usability, engagement, retention) remains a key challenge: numerous reviews highlight high attrition and under-reporting of digital features [12,14]. From a neuropsychiatric perspective, integration of multimodal data (neuroimaging, physiological monitoring, self-report) holds promise but remains rare in perinatal digital-health interventions. The digital doula model must therefore build bridges between front-end support interfaces and back-end data analytics/clinical workflows.

5. Neuropsychiatric Mechanisms and Brain–Behavior Correlates

Understanding how digital doula interventions might exert beneficial effects in the perinatal period requires a translational lens that links support-processes (emotional, informational, monitoring) to neural circuits, neuroendocrine systems, and brain-behaviour dynamics. Below we outline three mechanistic domains relevant to perinatal mental health and how they may interface with digital support.

5.1 Stress-Regulation Circuits and Neuroendocrine Adaptation

The perinatal period is characterized by dramatic fluctuations in hormones (estradiol, progesterone, cortisol, oxytocin) and associated neuroendocrine adaptations-changes that influence mood regulation, stress responsivity, and maternal behaviour. For example, a recent fMRI study showed that during pregnancy higher amygdala activation during emotion regulation tasks predicted reduced regulation success and increased depressive symptom scores [15]. Moreover, structural and resting-state connectivity changes in the prefrontal-amygdala circuits are evident in women with perinatal mood and anxiety disorders (PMADs), implicating disrupted top-down control of emotion and heightened salience network responsivity [16]. In the context of digital doula interventions, this mechanistic domain suggests that providing timely emotional and informational support-especially when triggered by digital biomarkers of heightened stress-could buffer dysregulated neuroendocrine responsivity and promote more adaptive circuit engagement (e.g., enhanced prefrontal control over limbic reactivity).

5.2 Neuroplasticity, Maternal Brain Adaptation & Cognitive-Emotive Processing

Pregnancy and the postpartum period involve significant brain plasticity: changes in grey matter volume, white matter microstructure, functional connectivity, and neural network topology have been documented in longitudinal studies of healthy peripartum women [17]. Although not yet fully integrated into the perinatal mental-health literature, these adaptations likely establish the neural substrate for maternal sensitivity, emotion regulation, and infant-care behaviour. In perinatal mood disorders, disturbances in this adaptation may contribute to cognitive-emotive difficulties: a recent study found that women at risk of postpartum psychosis exhibited worse executive function and processing speed in late pregnancy compared with low-risk women [18]. Digital doula interventions may engage this plasticity directly by providing stimuli (emotional scaffolding, psychoeducation, biofeedback) that promote adaptive restructuring of neural networks involved in emotion regulation, maternal bonding, and resilience. Embedding digital biomarkers (e.g., HRV, sleep metrics) and neurofeedback tools may further enhance this plastic adaptation.

5.3 Brain–Behaviour and Mother–Infant Dyadic Regulation

An additional mechanism concerns the dynamic coupling between maternal brain–behaviour and the developing infant system: maternal mood, stress regulation, and neural responsiveness impact infant neurodevelopment via behavioural synchrony, emotion co-regulation, and caregiving interactions. Recent work shows that prenatal maternal psychological distress is associated with altered fetal brain structure and connectivity (e.g., hippocampal growth impairment, increased cortical gyrification in frontal/temporal lobes) in offspring [19]. From a neuropsychiatric vantage, digital doula interventions that support maternal emotional regulation and reduce stress may promote healthier mother–infant neural and behavioural coupling, thereby conferring downstream benefits not only to the mother but to infant neurodevelopment and dyadic outcomes.

6. Ethical, Cultural, and Regulatory Considerations

As digital doula interventions expand into the perinatal neuropsychiatric domain, ethical, cultural and regulatory dimensions become central to safe, equitable, and effective deployment. Below we discuss three major domains: (1) data privacy, algorithmic bias and human-AI oversight; (2) cultural/contextual equity and accessibility; (3) regulatory frameworks, professional integration and accountability.

6.1 Data Privacy, Algorithmic Bias and Human-AI Oversight

Digital interventions-especially those incorporating AI, digital biomarkers or chatbots-collect, process and act on sensitive personal and mental-health data. Ensuring informed consent, relational trust, and autonomy within perinatal populations is imperative. A systematic review of ethical issues in perinatal mental-health research highlighted that trust between participants and researchers deeply influences consent, retention and overall study ethics [20]. Moreover, a review of generative AI in mental-health care noted that algorithmic bias, lack of transparency, risk of over-reliance on automated decisions and uncertain interpretability may compound risks for vulnerable users [21]. In the digital doula context, these issues translate to (i) rigorous data governance (storage, access, anonymization), (ii) transparent algorithmic logic and human oversight for emotional/mental-health support decisions, and (iii) continuous monitoring of unintended consequences (e.g., over-dependence on a digital agent, diminished human support). As one ethics commentary argues, focusing solely on fairness/technical bias is insufficient: the impact on human relationships and care processes must be central [22]. Finally, when digital platforms collect behavioural and physiological data (wearables, HRV, app usage) for personalisation, standards for data minimization and user autonomy are essential to preserve the neuropsychiatric-care ethos of the intervention.

6.2 Cultural, Socio-economic Equity and Accessibility

Digital doula interventions aim to enhance scalability and accessibility; yet digital divides, cultural relevance, language/literacy barriers and socioeconomic disparities may perpetuate or even exacerbate inequality. For instance, perinatal digital interventions remain concentrated in high-income settings, with limited representation from low- and middle-income countries (LMICs) [23]. Further, design research in perinatal digital mental-health interventions (e.g., persona development) emphasises that user-centred design must account for cultural norms, family structures, literacy levels and local support systems [24]. In this light, digital doula systems must be adaptable across cultural contexts, include multilingual/multicultural content, ensure low-tech access (e.g., offline modes, minimal data-usage), and integrate partner/family roles per cultural norms. Ethical implementation demands that digital-supports do not replace but rather complement human care, especially where cultural mistrust or limited digital literacy exists.

6.3 Regulatory Frameworks, Clinical Integration and Accountability

The regulatory landscape for digital health-and particularly AI-enhanced emotional support tools-continues to evolve. Currently, few regulatory frameworks explicitly address “digital doula”-type tools in perinatal neuropsychiatry. Telepsychiatry studies in perinatal populations have identified barriers such as licensing, reimbursement, technology access, clinician training and continuity of care [25]. Moreover, sustainable implementation of AI-based mental-health interventions is contingent on oversight of ethics (privacy, bias, human-in-loop), infrastructure (data security, connectivity), and cultural adaptation, all of which must align with clinical workflows and professional standards [26]. For digital doula systems, key regulatory/implementation priorities include: (i) classification of digital doula tools

(medical device vs. wellness app), (ii) certification and validation of AI components, (iii) integration with clinical care pathways (perinatal mental-health teams, obstetrics, psychiatry), (iv) training and role delineation between human doula, clinician, and AI/algorithmic support, and (v) monitoring of outcomes, adverse events and long-term engagement. Without such governance, the promise of scalable neuropsychiatric digital support may be undermined by issues of efficacy, safety and equity.

7. Future Directions and Clinical Translation

As the field transitions from proof-of-concept to large-scale implementation, the digital doula paradigm offers multiple promising avenues for innovation. At the same time, effective clinical translation will require strategic alignment across technology, neuroscience/psychiatry, health-systems and policy. Below we outline key future directions and pathways for clinical translation.

7.1 Precision Personalised Interventions

Looking ahead, one major direction is the tailoring of digital doula interventions to individual phenotypes and risk-profiles. This includes leveraging multimodal data (digital biomarkers from wearables, user behaviour data, psychometrics, possibly neuroimaging) to stratify users into risk clusters and adapt support intensity, modality and timing accordingly. For example, a recent review highlighted the potential of AI to improve perinatal mental-health prediction with AUCs in the range 0.71-0.84, suggesting a feasible basis for personalised risk-driven support [27]. Moreover, digital health interventions in perinatal depression have shown modest effect sizes (SMD≈0.29) but heterogeneity in delivery mode, timing and user engagement still limits maximised impact [23]. In the digital doula context, precision translation means: adaptive content (chatbot vs live doula), predictive alerts for elevated stress, and dose-modulated emotional support. Realising this calls for robust data pipelines, real-time analytics, and dynamic algorithmic adjustment.

7.2 Integration into Clinical Care Pathways

A critical translational step is embedding digital doula systems within existing perinatal care workflows-obstetrics, psychiatry, maternal & infant health services. This requires interoperability with electronic health records (EHRs), referral logic to human providers when risk thresholds are crossed, and clear role-definitions between digital and human doula/clinician teams. Digital mental-health literature emphasises that moving beyond standalone apps into system-integrated care is essential for uptake and sustained use [28]. Further, for scalability, training of human doulas, clinicians and support staff in digital tools, user-engagement strategies, and data-driven workflows will be needed. Business models (reimbursement, licensing, partnerships) must align with health-system priorities.

7.3 Multimodal Evaluation & Neuropsychiatric Outcomes

Future research should expand beyond self-report psychological outcomes to include neuropsychiatric endpoints: e.g., neuroimaging, neurophysiological metrics (EEG/HRV), and mother-infant synchrony measures. By doing so, we can link the digital doula support to demonstrable neural and behavioral mechanisms. A recent human-centred AI review underscores the need for restoration of user-state data (organism) and behavioural outcomes (response) in the stimulus–organism–response framework [29]. In practical terms, a future trial might evaluate a digital doula intervention's effect on maternal resting-state connectivity, HRV recovery post-labour, and mother–infant interaction quality at 3-months postpartum. Establishing such mechanistic links will strengthen clinical validity, regulatory acceptance and translational value.

7.4 Equity, Access and Global Scaling

While digital tools promise scalability, they risk exacerbating disparities if access, digital literacy, cultural adaptation and infrastructure are not addressed. Research shows digital interventions remain concentrated in high-income countries and often neglect partner/family inclusion [12]. For global translation of digital doula systems, key priorities include: offline/low-bandwidth versions, multilingual and culturally adapted content, inclusive design of AI algorithms, and business models LMICs. This aligns with broader calls for fairness and inclusivity in digital psychiatry [30]. Pilots in resource-limited settings with appropriate localization will be vital to validate system feasibility, acceptability and outcomes across diverse populations.

7.5 Regulatory, Ethical and Sustainability Frameworks

As digital doula interventions evolve, corresponding regulatory, ethical and sustainability frameworks must keep pace. Future directions involve: Certification of digital doula platforms as digital therapeutics or medical-device software when applicable. (ii) Implementing explainable AI (XAI) within intervention systems so clinicians and users understand decision logic and trust the system [30]. (iii) Building business models that ensure long-term sustainability (maintenance, updates, data security, infrastructure).(iv) Ongoing monitoring of unintended harms (over-dependency, privacy breaches, algorithmic drift) and adaptive governance. (v) Ethical monitoring inclusive of informed consent, cultural sensitivity, algorithm fairness and digital autonomy. (vi) Translation into routine practice will depend on balancing innovation with patient-safety, system-integration, and durable funding.

8. Discussion

The integration of digital doula systems into perinatal mental health care represents a transformative step toward precision, accessibility, and personalization in neuropsychiatric support. Across this review, we have traced the evolution from traditional, in-person doula care to AI-enabled, digitally mediated companionship that augments human empathy with technological scalability. This convergence reflects a broader paradigm shift in neuropsychiatry-one that positions digital technologies not merely as adjunct tools, but as integral components of clinical ecosystems for emotional regulation, resilience building, and early detection of psychological distress.

Empirical evidence suggests that digital and hybrid doula interventions hold measurable potential to reduce perinatal anxiety and depressive symptoms, enhance self-efficacy, and strengthen mother-infant bonding through continuous, adaptive engagement [12,31]. When powered by AI, these systems can capture multimodal digital biomarkers and behavioural data that allow for timely, individualized support aligned with neuropsychiatric risk profiles [27]. Integrating such systems within clinical care pathways-supported by interoperable data frameworks, ethical governance, and human oversight-will be essential to ensure both efficacy and trustworthiness [28]. However, several translational challenges remain. These include ensuring algorithmic transparency, achieving equity across socioeconomic and cultural contexts, validating neuropsychiatric outcomes beyond self-report, and establishing sustainable business and regulatory models. Continued interdisciplinary collaboration-among neuroscientists, psychiatrists, digital engineers, obstetric clinicians, ethicists, and policy makers-will be critical to navigate these frontiers.

9. Conclusion

Ultimately, the digital doula model offers a powerful illustration of how human-centred AI can extend empathy, accessibility, and precision in neuropsychiatric care. By aligning technological innovation with ethical stewardship and clinical rigor, digital doula systems could redefine the landscape of maternal mental health-transforming perinatal care from reactive symptom management to proactive, continuous, and personalized emotional well-being.

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