

# Summary

Neonatal care, particularly for preterm infants, demands innovative solutions to address vulnerabilities and prevent critical complications. This research explores the integration of advanced technologies like the Internet of Things (IoT) and artificial intelligence (AI) to enhance monitoring and outcomes in neonatal health. By leveraging IoT devices such as wearable sensors and smart incubators, the study enables real-time data collection in Neonatal Intensive Care Units (NICUs), reducing manual workloads and enabling early detection of health risks. A centralized data platform harmonizes diverse health metrics, supporting robust AI-driven analysis for improved clinical decision-making.

The study focuses on three core approaches: movement analysis to track neurodevelopmental progress and detect motor abnormalities, physiological signal processing to predict health outcomes like mortality or neurological risks, and facial expression analysis to identify pain, distress, or genetic conditions. These methods utilize AI to provide non-invasive, scalable tools for early diagnosis and intervention. For instance, motion-tracking algorithms reconstruct movement patterns to flag developmental delays, while voice and facial analysis models assess distress levels without invasive procedures.

A key emphasis is placed on transparent AI techniques, ensuring clinicians can interpret and trust algorithmic predictions. This transparency bridges the gap between complex models and practical clinical use, fostering trust and integration into NICU workflows. By combining real-time IoT data with explainable AI, the research offers tools that enhance prediction accuracy, support personalized care, and reduce long-term complications. Collectively, these advancements aim to improve survival rates, minimize developmental delays, and elevate the quality of life for neonates globally, demonstrating the transformative potential of technology in neonatal healthcare.