CHAPTER 8

Artificial Intelligence and Internet of Things for Clinical Decision Support in Neonatal Respiratory Monitoring

MUHAMMAD SYAUKANI
RINCHE ANNUR

ABSTRACT

Public health governance faces challenges in integrating neonatal monitoring data, detecting respiratory deterioration early, and supporting transparent clinical decision-making. This study proposes a Clinical Decision Support System based on Artificial Intelligence and Internet of Things technologies for monitoring neonatal respiratory disorders in intensive care settings. The study employs a system design research approach involving needs analysis, architecture development, artificial intelligence modelling, and conceptual evaluation. The proposed system integrates medical sensors, real-time data processing, and predictive analytics to support early warning and risk classification. Findings indicate that the model can enhance data integration, improve responsiveness in clinical decisions, and strengthen transparency and accountability in public health governance. The study contributes a practical framework for implementing intelligent neonatal monitoring systems and provides policy implications for future digital health governance.

Introduction

Neonatal health is a fundamental component of public health because neonatal survival reflects the quality, accessibility, and effectiveness of healthcare systems. According to the World Health Organization (WHO), approximately 2.3 million newborns died during the first 28 days of life in 2022, representing nearly half of all deaths among children under five years of age[1]. Respiratory disorders, prematurity, infections, and birth-related complications remain among the leading causes of neonatal mortality worldwide. These conditions often require immediate clinical intervention and continuous monitoring to prevent deterioration. Consequently, improving neonatal respiratory monitoring has become a strategic priority not only for healthcare professionals but also for policymakers and healthcare institutions seeking to reduce neonatal mortality rates, improve quality of care, and strengthen public health outcomes. Effective respiratory monitoring contributes to patient safety, healthcare efficiency, and evidence-based decision-making, making it a critical element of modern neonatal healthcare services.

The growing complexity of neonatal care has encouraged healthcare systems to adopt advanced digital technologies capable of supporting real-time monitoring and rapid clinical responses. In Neonatal Intensive Care Units (NICUs), healthcare professionals are required to continuously observe physiological parameters such as respiratory rate, oxygen saturation, heart rate, and body temperature. However, conventional monitoring approaches often generate large volumes of data that may be difficult to interpret promptly, particularly in busy clinical environments. Delays in recognizing early signs of respiratory deterioration can lead to severe complications and increased mortality risks. Therefore, innovative technological solutions are required to improve monitoring accuracy, enhance clinical responsiveness, and support more effective healthcare delivery.

Artificial Intelligence (AI) has emerged as one of the most transformative technologies in healthcare and is increasingly recognized as a key driver of digital health innovation. AI enables computers and intelligent systems to analyze complex medical data, identify hidden patterns, predict clinical outcomes, and provide decision

[1] WHO. 2024. "Newborn Mortality." Geneva: World Health Organization. https://www.who.int/news-room/fact-sheets/detail/newborn-mortality

support to healthcare professionals. Recent developments in machine learning, deep learning, and predictive analytics have demonstrated significant potential to improve diagnostic accuracy, optimize treatment planning, and reduce clinical errors across various healthcare domains. In neonatal medicine, AI technologies can assist clinicians in detecting early signs of respiratory distress, predicting disease progression, and identifying patients who require immediate intervention. Consequently, AI has become an important tool for improving the quality, efficiency, and safety of neonatal healthcare services.

At the same time, the rapid advancement of the Internet of Things (IoT) has transformed healthcare monitoring capabilities by enabling the continuous collection and transmission of physiological data through connected medical devices. IoT-based healthcare systems facilitate real-time monitoring, remote observation, and seamless communication between medical equipment and healthcare providers. In neonatal care, non-invasive wearable sensors and smart monitoring devices have demonstrated considerable potential for continuously measuring vital physiological parameters while minimizing discomfort and risks for newborn patients. Recent studies have shown that advances in sensor technologies significantly improve the reliability, accuracy, and effectiveness of neonatal health monitoring systems, thereby supporting better clinical outcomes and patient safety[2].

The integration of Artificial Intelligence and the Internet of Things, commonly referred to as Artificial Intelligence of Things (AIoT), has introduced a new paradigm in healthcare innovation. AIoT combines the real-time data acquisition capabilities of IoT devices with the analytical intelligence of AI systems to create adaptive, predictive, and data-driven healthcare environments. Through AIoT, healthcare systems can move beyond traditional reactive approaches toward proactive and preventive healthcare management. Continuous physiological data collected through smart medical devices can be analyzed instantly using AI algorithms, enabling healthcare professionals to identify abnormalities, predict potential complications, and implement timely interventions. Such capabilities are particularly important in NICU environments, where patient conditions can change rapidly and require immediate clinical attention.

---

[2] Mishra, Shivam, Khouqeer, Ghada A., Aamna, B., Alodhayb, Abdullah, Ibrahim, S. Jafar Ali, Hooda, Manish, and Jayaswal, Gaurav. 2023. "Recent advancements in sensor technology for non-invasive neonatal health monitoring." *Biosensors and Bioelectronics X*, 14: 100332. https://doi.org/10.1016/j.biosx.2023.100332