A novel model for real-time monitoring of IVH in preterm neonates using non-invasive cardiac output (NICOM) parameters and Uber architecture for special event forecasting

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The Global Health Network

URL: https://tghncollections.pubpub.org/pub/smfwx1nw
Newborns in the neonatal period (first 28 days of life), undergo numerous physiological adaptations for extra-uterine life, during which they are vulnerable to many diseases and disorders. Preterm neonates - neonates with gestational age less than 37 weeks, are, however, more vulnerable, particularly in the first week. Intraventricular haemorrhage (IVH), with an occurrence rate of around 15 - 20%, is one of the most frequent complications in premature neonates. It can lead to lifelong impairments including cerebral palsy.

The acceptance of non-invasive cardiac output monitors (NICOM) in neonatal intensive care units (NICUs) has helped to generate massive amounts of data, however, they have largely remained in data silos unmined. Data analytics has the potential to facilitate earlier detection of clinical deterioration, expedite the application of efficient clinical decision-making algorithms based on real-time and historical data mining, and yield significant cost savings. Although several studies exist that have predicted the risk of IVH in preterm, none has explored the potential of using NICOM data.

In this study, we adapted an end-to-end neural network architecture developed at Uber for forecasting extreme events. We trained the network with NICOM data from 40 preterm neonates since we consider IVH occurrence an extreme event in the NICU. Each sample data is a 4-hour continuous recording of cardiac output (CO), stroke volume (SV), heart rate (HR), cardiac index (CI), ventricular ejection time (VET) and stroke volume variation (SVV). With this approach, we used 300 minutes of continuous data to forecast the cardiac output in the following 60 minutes. Our model achieved a mean absolute error of 0.02 with a standard deviation of 0.0004.