AI can be trained to detect lung disease in premature babies, research suggests

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Artificial Neural Networks (ANNs) can be trained to detect lung disease in premature babies by analyzing their breathing patterns while they sleep, according to research presented at the European Respiratory

Society (ERS) Congress in Vienna, Austria.

The study was presented by Edgar Delgado-Eckert, adjunct professor at the Department of Biomedical Engineering at the University of Basel, and a research group leader at the University Children's Hospital, Switzerland.

Bronchopulmonary dysplasia (BPD) is a breathing problem that can affect premature babies. When a newborn's lungs are undeveloped at birth, they often need support from a ventilator or oxygen therapy—treatment which can stretch and inflame their lungs, causing BPD.

But identifying BPD is difficult. Lung function tests usually require an adult to blow out on request—something babies cannot do—so current techniques require sophisticated equipment to measure an infant's lung ventilation characteristics. As a result, BPD is one of only a few diseases that is typically diagnosed by the presence of one of its main causes, prematurity and respiratory support.

ANNs are mathematical models used for classification and prediction. In order to make accurate predictions, an ANN needs to first be trained with a large amount of data, which presents a problem when it comes to BPD.

Professor Delgado-Eckert explains, "Until recently, this need for large amounts of data has hindered efforts to create accurate models for lung disease in infants, because it is so difficult to assess their lung function.

"But there is an alternative. We can measure a baby's breathing while they sleep. All this needs is a soft face mask, with a sensor that can measure the air flow and volume entering and leaving the infant's nose. This equipment is cheap and available at any clinical facility.

"Such measurements of several consecutive breaths—what we call tidal breathing—can yield large amounts of good quality sequential flow data. We wanted to try and use this data to train an ANN to detect BPD.

Professor Delgado-Eckert's team studied a group of 139 full term and 190 premature infants who had been assessed for BPD, recording their breathing for ten minutes while they slept. For each baby, 100 consecutive regular breaths, carefully inspected to exclude sighs or other artifacts, were used to train, validate, and test a type of ANN called a Long Short-Term Memory model (LSTM), which is particularly effective at classifying sequential data such as tidal breathing.

The team used 60% of the data to teach the network how to recognize BPD, 20% to validate the model (to ensure it wasn't too fixed on the training data), and then fed the remaining 20% of the data to the model, unseen, to see if it could correctly identify those babies with BPD.

The LSTM model was able to classify a series of flow values in the unseen test data set as one that belonged to a patient who was diagnosed with BPD or not with 96% accuracy.

Professor Delgado-Eckert added, "Our research delivers, for the first time, a comprehensive way of analyzing the breathing of infants, and allows us to detect which babies have BPD as early as one month of corrected age—the age they would be if they had been born on their due date—by using the ANN to identify abnormalities in their breathing patterns.

"Our non-invasive test is less distressing for the baby and their parents, means they can access treatment more quickly, and may also be relevant for their long-term prognosis"

The team now hope to investigate whether the model could also be used

to test babies just a few weeks after birth, to analyze lung function and predict symptoms in older, school-age children, and to test for other conditions, such as asthma.

Professor Angela Zacharasiewicz is Chair of the ERS Pediatric Asthma and Allergy Group and Head of the Department of Pediatrics, Klinik Ottakring, and was not involved in the research.

She said, "Testing the function of the lung in premature babies using new techniques will improve therapeutical decision making. The earlier we can confirm BPD in a premature infant, the quicker we can make an informed decision about the best form of respiratory support to give them during their first weeks of life. It could also allow for the earlier planning of follow-up assessments and potential interventions, reducing stress for parents and their children.

"This research shows the huge potential AI has in simplifying this process. This technique could be used for testing larger numbers of babies and could also be applied to other diseases, such as asthma.

"It's exciting to see how AI tools like these can potentially support our health services."

More information: Abstract no: OA4655 "Detection of bronchopulmonary dysplasia (BPD) in preterm infants with an artificial neural network (ANN) trained using air flow time series (TS) measured during tidal breathing (Tb)", by Edgar Delgado-Eckert et al; Presented in session, "Assessment of ventilation in awake and sleeping children" at 11:00-12:15 CEST on Tuesday 10 September 2024. [k4.ersnet.org/prod/v2/Front/Pr … ?e=549&session=17949]

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