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Risk Stratification in Newborns Based on Metabolites Using Deep Learning

Prematurity is the single largest cause of death in children under 5 years of age, both in low-and high-income countries. The heterogenous nature of neonatal morbidities that account for poor long-term outcomes, and lack of predictive models, has prevented precision-medicine approaches that are needed for reducing the impact of this global challenge. Researchers at Stanford have developed a method for quantitative assessment of neonatal health using dried blood spot metabolite profiles and deep learning. Prematurity is associated with significant newborn health risks, including intraventricular hemorrhage (IVH), bronchopulmonary dysplasia (BPD), necrotizing enterocolitis (NEC) and retinopathy of prematurity (ROP). Current diagnosis and treatment of the latter three conditions are reactive to the occurrence and onset of typical symptoms. Moreover, current classification methods for preterm birth (gestational age and birthweight) can vary widely with regard to adverse health outcomes and thus of limited value for risk stratification. To create a more comprehensive approach, the Stanford team linked quantitative metabolite results from routine newborn screening (NBS) dried blood spots representing over 40,000 livebirths to clinical outcomes. Using deep learning, NBS metabolites were condensed into a metabolic health index predicting the likelihood of suffering from the four adverse neonatal outcomes described above. Their results show that premature newborns can be risk stratified on the basis of metabolic vulnerability through deep learning approaches. Further development of the metabolic and algorithmic definition of preterm risk has the potential to improve treatment decisions in the most vulnerable neonatal patients.

Stage of Development

Future work will focus on performance improvements and validation of algorithmic risk stratification using other available NBS metabolite values.

Applications

- Algorithmic assessment of neonatal health

Advantages

- Creating a biological basis for comprehensive newborn risk assessment should improve risk quantification and disease diagnosis
- Enables early stratification to appropriate care pathways
- An NBS-based metabolic taxonomy of prematurity has widespread translational potential as NBS metabolite values are collected as a part of routine neonatal screening in hospitals throughout North America

Patents

- Published Application: WO2022256850

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