RESEARCHER PROFILE
VERA NENADOVIC

RESEARCH GOALS
Brain injuries represent the biggest cause of death and acquired disability in paediatric patients. These can be caused by, for example, infections, trauma or cardiac arrest. Due to the economic and social cost, improvements in accurately determining the prognosis of patients are urgently needed. This information could inform clinicians on the best course of treatment for individual paediatric patients.

Researchers led by Vera Nenadovic, a nurse practitioner in paediatric neurology at The Hospital for Sick Children, Toronto, Canada, have been working to develop accurate numerical indices that indicate the clinical outcome of brain injury in paediatric coma patients at an early stage. The group wants to measure the brain activity of comatose children in real time. Continuous measurements using electroencephalography (EEG) are currently used to detect subclinical seizures but these methods create large amounts of data that are typically unmanageable by clinicians and prevent real-time feedback.

METHOD
For their research, Nenadovic and her team are using an EEG – a device that is typically portable and can record brain activity changes on the scale of milliseconds, making it a powerful technique for rapidly reporting changes in a patient’s status. The phase synchrony of neurons can be reported using EEG readings and is termed the R index. Modulations in R index occur prior to subclinical seizures and are therefore useful as an early warning of a change in the patient’s status. This spatio-temporal variability of the R index can also be analysed by EEG, proving the perfect tool for Nenadovic’s work.

Nenadovic has developed a series of algorithms called EEG for Knowledge Integration and Decision Support (KIDS) that can be integrated into current data monitoring systems. These algorithms track both phase synchrony and variability and act as indicators of the disease state. They take the complex waveforms produced by the EEG machine and translate them into comprehensible indices for clinicians.

IMPACT
The algorithms developed by Nenadovic and her colleagues have resulted in a tool that can continuously reflect alterations in cortical activity in terms of brain injury outcome. Their studies found that increased complexity of neuronal patterns was associated with a good disease prognosis. As well as providing clinicians with invaluable information regarding a patient’s brain activity status, the group’s algorithms also created a method by which the impact of current treatment options can be analysed by studying the association with changes in phase synchrony variability. The EEG-KIDS system can therefore initiate several strands of novel research aiming to improve knowledge of routine brain injury treatments.

Nenadovic is now looking for integration of the EEG-KIDS system with other monitoring systems, for use in critical care units with existing continuous EEG monitoring capabilities nationally and internationally. These methods will hopefully make a real difference in the way clinicians and families plan for the care of paediatric patients and fully understand the impacts of treatment on altering brain injury prognoses.