

A prospective clinical study on the use of a non-invasive wearable device and neural network models for patients with dengue

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Introduction

Dengue epidemics impose considerable strain on healthcare resources. Real-time continuous and non-invasive monitoring of patients admitted to hospital could lead to improved care and outcomes. We evaluated the performance of a commercially-available wearable (SmartCare) utilising photoplethysmography (PPG) to stratify clinical risk for a cohort of hospitalised dengue patients in Vietnam.

Methods

We performed a prospective observational study for adult and paediatric patients with a clinical diagnosis of dengue at the Hospital for Tropical Disease, Ho Chi Minh City, Vietnam. Patients underwent PPG monitoring early during admission alongside standard clinical care. PPG waveforms were analysed using machine learning models. Adult patients were classified between 3 severity classes: i) uncomplicated (ward-based), ii) moderate - severe (ED-based), and iii) severe (ICU-based). Data from paediatric patients was split into 2 classes: i) severe (during ICU stay) and ii) follow-up (7-14 days after discharge). Model performances were evaluated using standard classification metrics and 5-fold stratified cross validation.

Results

We included PPG and clinical data from 132 adults and 15 children with the median age of 28 and 12 years respectively. 1781-hours of PPG data were available for analysis. The best performing convolutional neural network model (CNN) achieved precision of 0.785 and recall of 0.771 in classifying adult patients according to severity class and precision of 0.891 and recall of 0.891 in classifying between disease and post-disease state in paediatric patients.

Conclusion

We demonstrate that use of a low-cost wearable provided clinically-actionable data to differentiate between patients with dengue of varying severity. Continuous monitoring and connectivity to early warning systems could provide significant benefit to clinical care in dengue, particularly within an endemic setting. Work is currently underway to implement these models for dynamic risk predictions and provide individualised patient care.