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User-Centred Designed CDSS for Sleeping Staging in Polysomnography

South Korean researchers recently developed an artificial intelligence (AI)-based clinical decision support system (CDSS) to assist polysomnographic technicians in reviewing AI-predicted sleep staging results.

Sleep staging is a time-consuming and costly process. The lack of clinical interpretability and user-centred interfaces impede the adoption of AI systems. Challenges to its automation include questions surrounding the reliability of model predictions, the clinical soundness of the model, and social consensus on model use. Manual review of automated results remains mandatory. Thus, to use an AI system, it must provide explainable factors which most deep-learning systems do not.

To address these shortcomings, the CDSS system was designed around a framework that identifies why explanations are needed, what information should explanations contain, and optimal methods for providing explanations in the CDSS. To identify critical points for CDSS explanation design, the researchers conducted user interviews, observation sessions, and used an iterative design process. After constructing the CDSS, its performance in aiding polysomnographic technicians was evaluated through the accuracy of the sleep staging and through participant interviews. Nine polysomnographic technicians quantitatively and qualitatively investigated the helpfulness of the CDSS.

The study revealed that 80% of technicians wanted clinically sound explanations relevant to sleep staging electroencephalogram (EEG) patterns to assess the correctness of AI predictions based on their knowledge. The explanation types should include signal occurrence (dependent on proper detection), the ratio of signals, and changes in the amplitude of the signals.

The iterative design process involved checking with the technicians to understand how they wanted the raw signals refined and presented to highlight clinically relevant aspects. Overall, the participating technicians felt that these features reduced their workload and provided a helpful quantitive visual reference. Thus, the CDSS has excellent potential to be integrated into the real-world clinical workflow of a sleep laboratory.

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