

AI Advisor: An Explainable AI Decision Aid For Cognitive Decline Risk Stratification Using Actigraphy Data

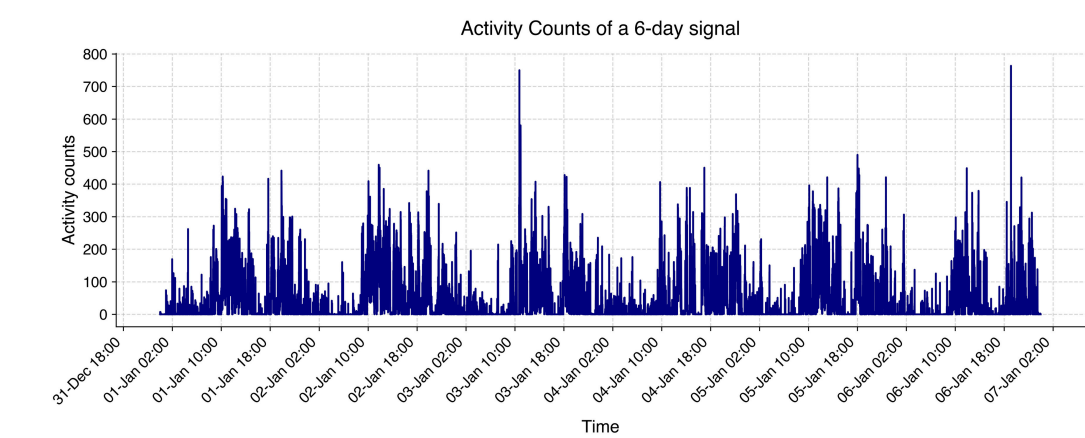
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Explainable AI turns actigraphy-based machine learning into a clinically useful tool for cognitive decline risk assessment.

INTRODUCTION

Early cognitive risk detection supports timely intervention and stratification.

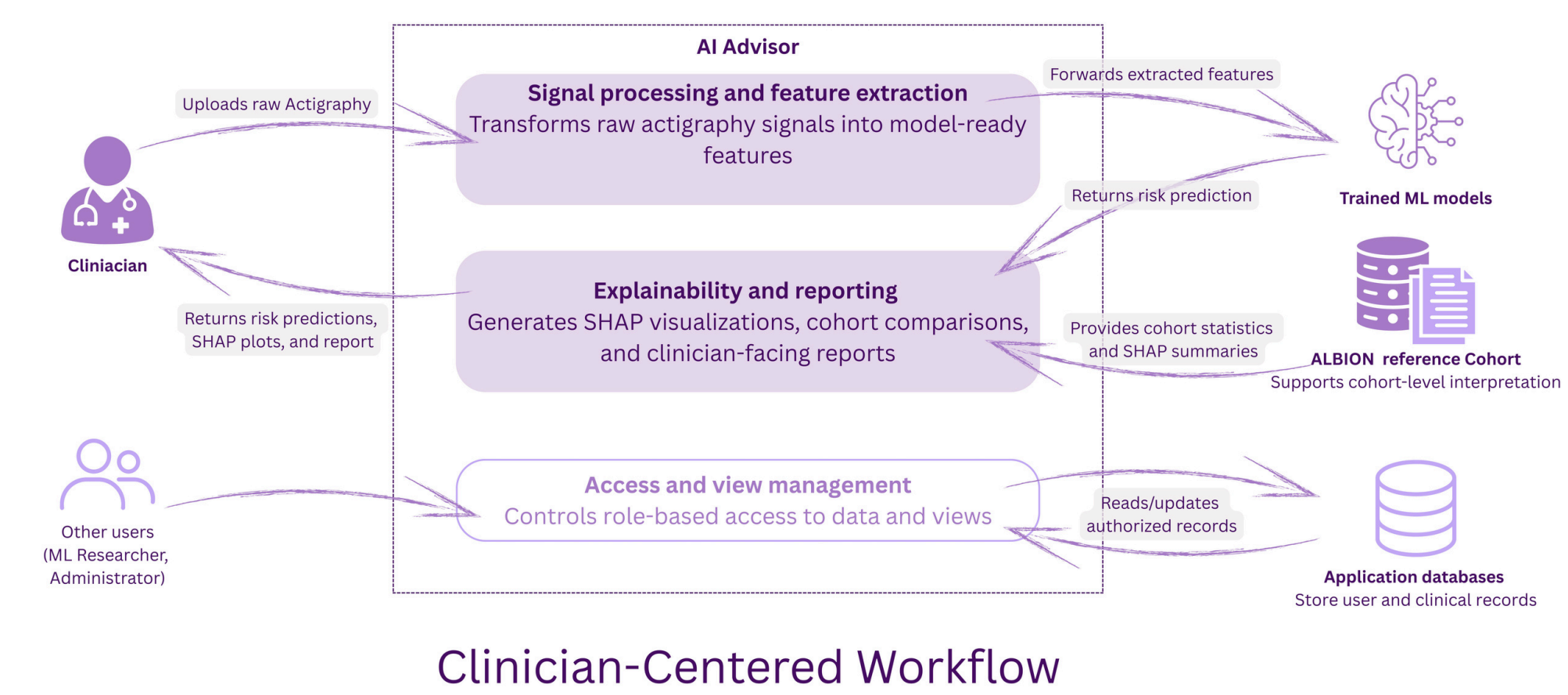


Actigraphy-derived sleep-wake and circadian patterns may reveal early MCI-related alterations.

Using the ALBION cohort, a Greek study of aging and cognitive decline [1], we developed AI Advisor.

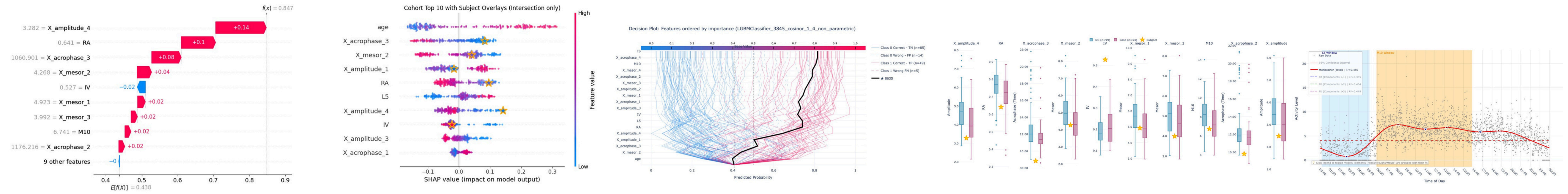
METHODS

Raw actigraphy was transformed into multicosinor, wavelet, and nonparametric features. Two model families were supported: high-complexity ensemble models and parsimonious linear models. SHAP-based visualizations were used to support both prediction and interpretation [2–4]. A Streamlit-based application was developed to deliver clinician-facing inference, explanation, and reporting.



RESULTS

AI Advisor demonstrated that cognitive risk predictions can be linked to interpretable circadian and sleep-wake features at both subject and cohort level [3,4].



Waterfall plot: shows how each feature shifts the subject’s prediction. Most circadian features push the prediction toward MCI, with rhythm strength (amplitude), circadian timing (acrophase), and day-night contrast (RA) contributing most stronglyntributing most strongly.

Beeswarm plot: ranks cohort-level feature importance and places the patient within that context. Age, circadian timing (acrophase), and average rhythm level (mesor) are the model’s most influential features.

Decision plot: shows how feature contributions accumulate to the final prediction and compares the current patient with cohort trajectories. The highlighted path illustrates how multiple circadian features jointly push the subject’s prediction toward MCI.

Patient-vs-cohort boxplots: compare the patient’s values for SHAP-selected features with the control and MCI cohort distributions. The subject deviates from the control range in several circadian markers, aligning more closely with the MCI-associated profile.

Multicosinor plot: overlays the multicosinor fit on the patient’s activity signal and marks the L5 and M10 windows, corresponding to the least and most active periods of the day.

CONCLUSIONS

AI Advisor combined predictive models with SHAP-based local and global interpretation, enabling actigraphy-based MCI risk estimates to be traced back to specific circadian and sleep-wake features.

REFERENCES

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[2] Cornelissen G. Theor Biol Med Model, 2014.
[3] Lundberg SM, Lee SI. NeurIPS, 2017.
[4] Lundberg SM, Erion G, Chen H, et al. Nat Mach Intell, 2020.

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