Remarkable research for healthy ageing

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Preventing rehospitalizations of elderly acute care survivors using longitudinal physical and mental health monitoring with wearable sensors and smartphones

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Introduction

Wearable sensors have the potential to monitor the quality of life in elderly ICU patients after discharge.

Objective: To explore the potential of objectively characterizing the physical activity (PA) and sleep of elderly acute care survivors longitudinally towards providing new clinically useful and actionable insights, capitalizing on wearable sensors.

Research Background

Post-intensive care syndrome, or PICS, is made up of health problems that remain after critical illness. [1]

ICU Survivors

Physical Impairments

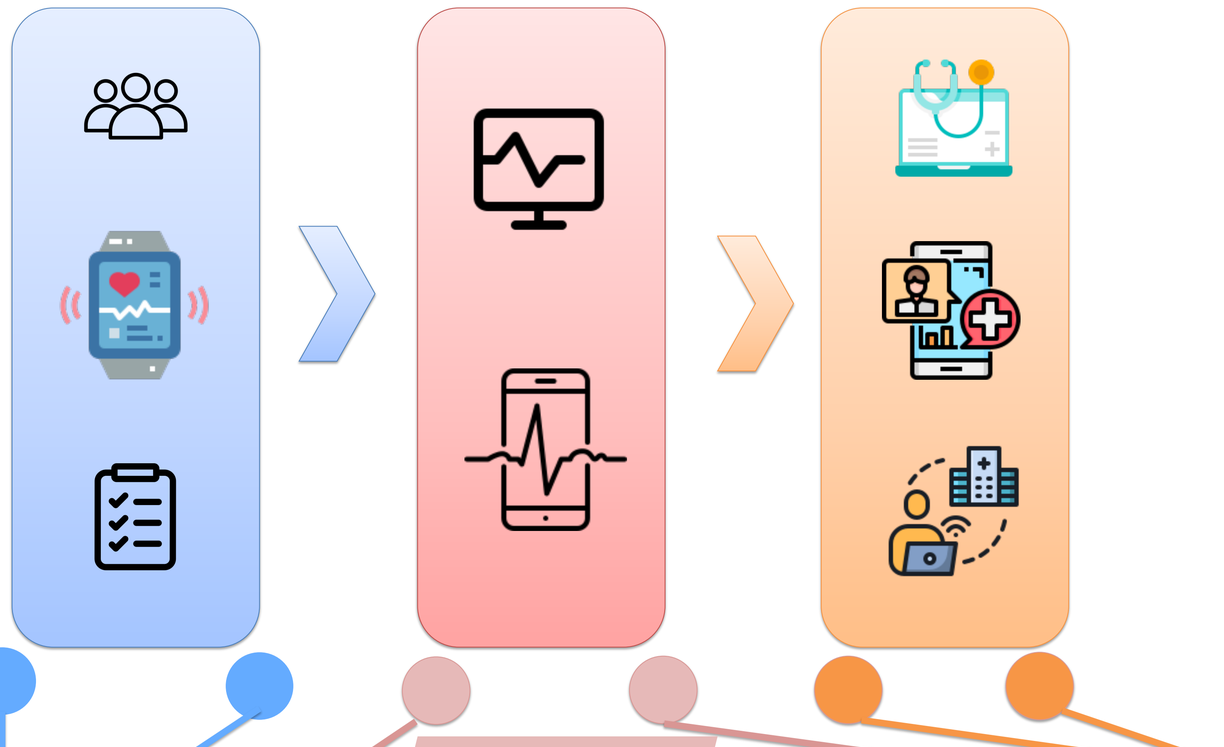
Cognitive Impairments

Mental Health Problems

Data

Public dataset:
CAPTURE-24, an accelerometer validation study of 152 adults aged 18–91 recruited by advertisements in Oxford, UK, in 2014–2015, was used to develop machine-learning classification methods. [2]

Study dataset:
The study will recruit 40 ICU patients and collect data (accelerometry data, demographic, EuroQol 5-dimensions 5-levels (EQ-5D-5L) survey, and Pittsburgh Sleep Quality Index (PSQI) survey) for one month post-discharge.



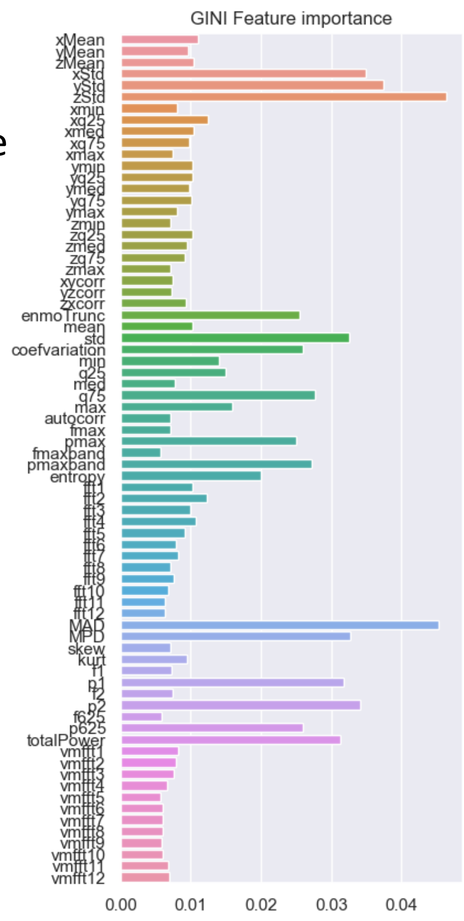
Methods

Data pre-processing

Labelling Classes, the Capture-24 dataset include fine-grained labels were mapped to sleep, sedentary behaviour, light PA behaviours and moderateto-vigorous PA behaviours. [3]

Feature Engineering

- Using rotation-invariant time and frequency domain features of the accelerometer signal.
- Try to use GINI importance to optimise feature extraction.



Models

- Three machine learning algorithms will be used: decision trees, random forest (RF), and XGBoost.
- As they did not use time sequence information, the behaviour sequence was smoothed using a Hidden Markov model (HMM).

Metrics

The algorithms will be benchmarked with two metrics: mean accuracy and Cohen's kappa in leave-one-participant-out analysis.

Future work

- The Capture-24 dataset-trained model to monitor post-ICU discharge patients through transfer learning.
- Support the development of an interface that could be used in clinical practice.

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References: 1. Desai, S. V., Law, T. J., & Needham, D. M. (2011). Long-term complications of critical care. Critical care medicine, 39(2), 371-379.
2. Chan Chang, S., Walmsley, R., Gershuny, J., Harms, T., Thomas, E., Milton, K., ... & Doherty, A. (2021). Capture-24: Activity tracker dataset for human activity recognition.
3. Walmsley, R., Chan, S., Smith-Byrne, K., Ramakrishnan, R., Woodward, M., Rahimi, K., ... & Doherty, A. (2022). Reallocation of time between device-measured movement behaviours and risk of incident cardiovascular disease. British journal of sports medicine, 56(18), 1008-1017.