# Proactive health monitoring based on Activities of Daily Living (ADLs)



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# Introduction & Motivation

Adverse health outcomes, including heart failures, falls etc., are not random occurrences, but a consequence of long-term health deterioration or unhealthy lifestyle. Detecting early evidence of such can help intervene proactively, reduce risks and increase healthy life expectancy. Our research project, in collaboration with the Advanced Care Research Centre [1] at the University of Edinburgh, aims to exploit smart home and wearable sensor data to detect patterns of health deterioration or deviation from a healthy routine. In order to provide key insights for preventative interventions and effective care, we extract causal interpretations of deviations by analysing the relationships between activities.

## Aim

• Detecting deterioration and deviations from a healthy routine.

## Methodology

Firstly, using process mining, we build workflow models that can detect deviating sequences of activities, such as forgetting medication after a meal. Secondly, machine learning (ML) models allow us to develop rich temporal profiles of daily routines, including sleep duration, number of meals, and levels of active movement, and detect deviations on individual days or in the long term.

• Interpreting the deviations and investigating the relationship between sleep and other activities.

## Background

We analysed ADL data form the CASAS data set by Cook et al [2]. This includes continuous data from unobtrusive ambient sensors in smart homes labelled with corresponding activities, including sleeping, cooking, eating, napping, going to the toilet, working, etc. for a sample of 11 participants over 2 months.





#### Results

#### Dashboard to explore daily deviations from predicted routine





#### Feature importance plot for sleep duration using Random Forest



### Conclusions and Future Work

Preliminary results indicate "personal hygiene" activities and the morning wake up time as the strongest predictors of regular sleep duration, whereas naps and nightly toilet visits seem to have a weaker correlation.

We believe our research can provide personalised, long-term health monitoring related to ADLs, producing key insights for preventative interventions and effective care provision. Such a solution can help improve independent living, particularly for people in advanced age in a care-at-home or care home environment. It can also reduce the burden in primary and social care through early prevention and reduced admissions.

Dealing with such noisy data and unpredictable routines continues to be a challenge, and results need to be contextualised to the needs and lifestyles of the individual participants. Further data collection and analysis beyond the limited dataset we have explored so far is likely to improve the quality of our algorithms and lead to new types of insights particularly for long-term predictions.

## Reference

1. The University of Edinburgh. 2021. Advanced Care Research Centre. [online] Available at: http://edin.care [Accessed 1 November 2021]. 2. D. J. Cook, A. S. Crandall, B. L. Thomas and N. C. Krishnan, "CASAS: A Smart Home in a Box", in Computer, vol. 46, no. 7, pp. 62-69, July 2013, doi: 10.1109/MC.2012.328.