D2.5 Implemented algorithms for WB detection, step detection, RWS estimate, secondary outcomes and confounders [Confidential Deliverable]

Submitted: November 2020

Summary

The objective of WP2 is to provide a “sensor – algorithm” pair that allows the valid and reliable assessment of digital mobility outcomes (DMOs), such as real-world walking speed (RWS). State-of-the-art algorithms that work robustly for diverse patient populations in free-living environments taking confounding parameters (such as using of walking aids) into account need to be implemented. The combination of those algorithms will provide a valid estimation of DMOs.

This deliverable describes the work done to define and implement the pipeline from raw sensor data to the final DMO using a variety of algorithms and methods. This process consists of the following parts:

1) A thorough definition of what is going to be measured in which situations (definition of DMOs)

2) Identification of suitable algorithms (from the literature and the consortium)

3) Implementation of algorithms and analysis pipelines considering the above definitions

4) Implementation of a structured collaborative development and deployment process. This allows to parallelly implement algorithms and pipelines ensuring reproducibility of results

5) Implementation of methods to acquire and analyse confounding factors (e.g., use of walking aids) that may influence patients’ mobility

In a consensus process conducted within the consortium, we obtained DMO definitions regarding what we consider purposeful walking in the real world to extract DMOs such as walking speed. Those definitions were used to derive pipelines that deal with the extraction of RWS. In a systematic literature review, we obtained an overview of relevant algorithms for walking speed and related steps/cadence and step length parameter estimation using only a single sensor device. Furthermore, potential algorithms for the assessment of secondary digital mobility outcomes (e.g., symmetry, variability, complexity of gait) were identified within the consortium.

The identified algorithms were implemented in their original and improved form (based on available pre-technical validation data) collaboratively using version management (Git) and packaged on a data and algorithm platform (e-Science). These algorithms include gait sequence detection (8 algorithms), step detection (17 algorithms), cadence estimation (17 algorithms), step length estimation (16 algorithms), left/right distinction (3 algorithms), turning detection (1 algorithm), height estimation (1 algorithm), walking bout assembly (1 algorithm), and secondary digital mobility outcome algorithms (8 algorithms). Methods to acquire and analyze confounding and contextual factors from smartphone and Bluetooth beacons were also implemented to be able to better interpret obtained DMO data with regard to those confounding variables.