# Towards digital mobility outcome measures in Parkinson's disease: Mobilise-D to EJS ACT-PD

Alison J Yarnall[1], ML Zeissler[1], G Mills[2], C Girges[2], C Gonzalez-Robles[2], A Noyce[3], A Jha[2], C Lambert[2], K Hockey[4], M Bartlett[4], MT Hu[5], S Haar[6], H Hiden[1], D Singleton[7], I Neatrour[1], L Sutcliffe[1], C Pugh[2], C Shakeshaft[2], A Schrag[2], T Foltynie[2] , L Alcock[1], S Del Din[1], L Rochester[1], CB Carroll[1]

[1]Newcastle University, UK; [2]University College London, UK; [3]Queen Mary University of London, UK; [4]Expert through Experience, UK; [5]University of Oxford, UK; [6]University of Surrey, UK; [7]University College Dublin, Ireland

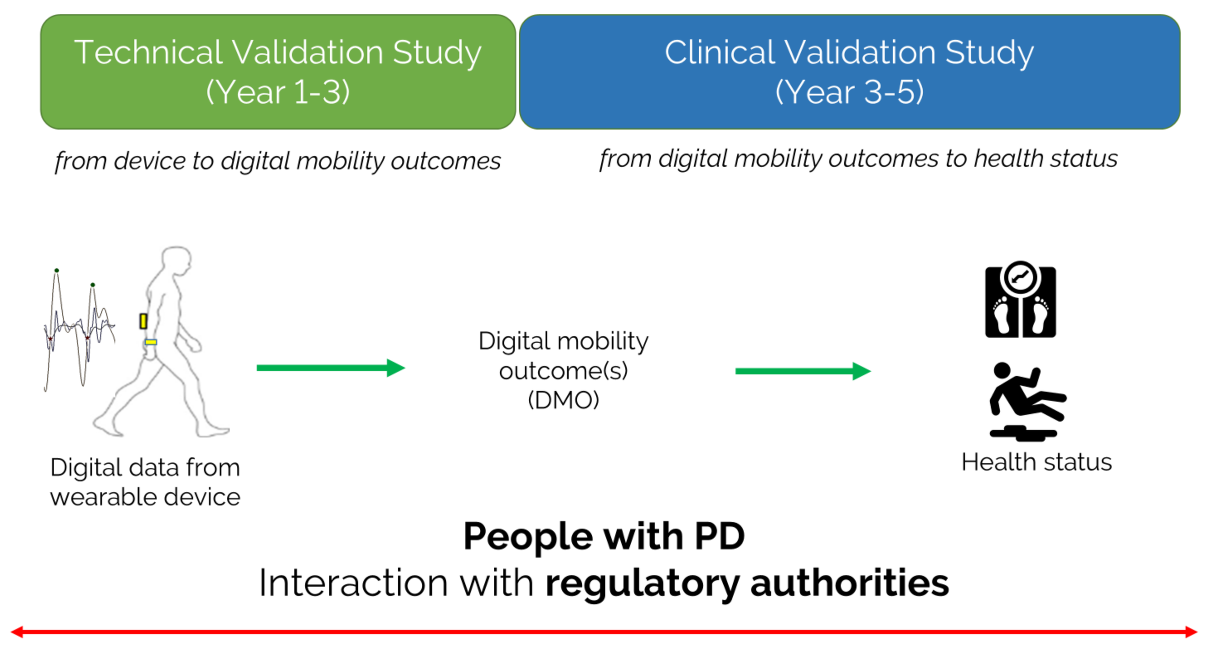
## Background:

### Disease modification in PD:

- A key challenge for disease-modifying trials in Parkinson's disease (PD) is the lack of sensitive, patient-relevant outcome measures.
- Digital mobility outcomes (DMOs), captured using body-worn devices, offer a novel, objective means to assess real-world gait and mobility[1].

### The Mobilise-D study:

- The Mobilise-D study validated DMOs in PD, demonstrating that the analytics software could accurately and reliably monitor mobility in the real world[1,2,3,4].
- However, to progress towards regulatory qualification, demonstration of responsiveness to therapy is required.




### Why include a digital measure in EJS ACT-PD?

The Edmond J Safra Accelerating Clinical Trials in Parkinson's Disease (EJS ACT-PD) multi-arm multi-stage (MAMS) trial provides a unique opportunity to advance the work of Mobilise-D.

#### Aim:

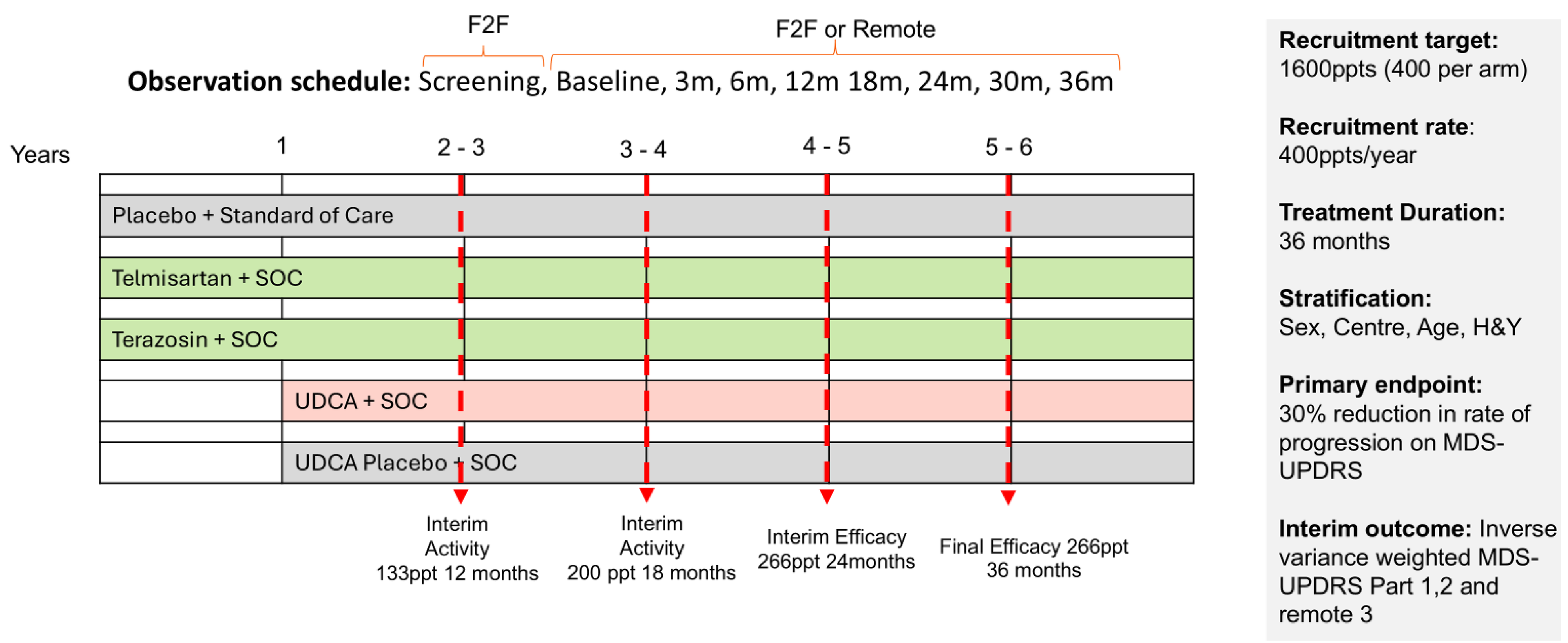
To understand whether a digital measure of motor performance will detect changes over time reflective of PD progression with greater sensitivity than traditional rating scales.

## Methods:

### EJS ACT-PD: a MAMS Trial

- A MAMS trial represents an innovative approach to complex clinical trial design (Figure 1).
- MAMS platform trials can simultaneously recruit to multiple active treatment arms to be assessed against one shared placebo arm.

**Figure 1**: The EJS ACT-PD MAMS design

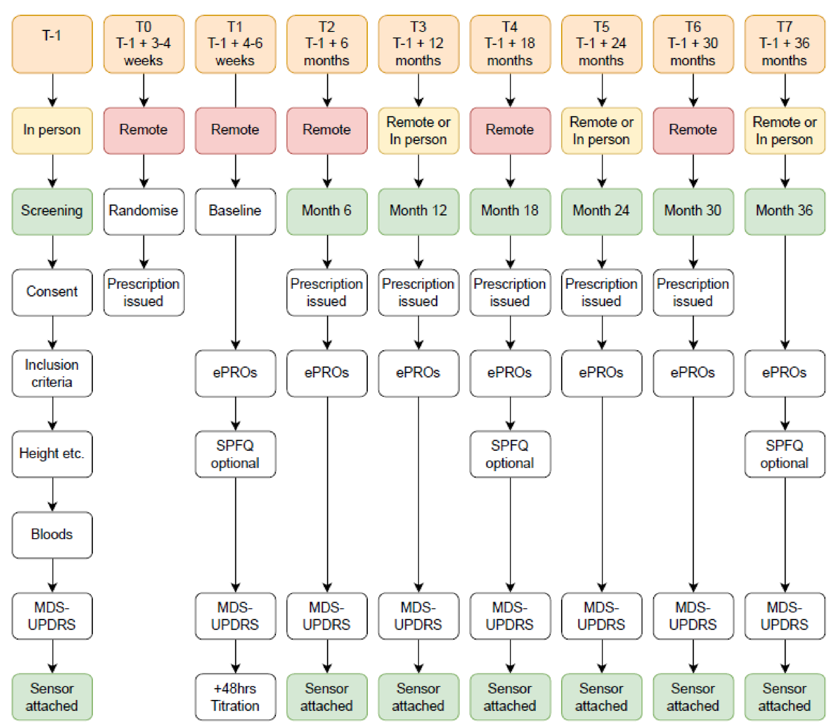



- The EJS ACT-PD trial will recruit 1600 participants across 43 sites. It commenced in September 2025 with two active treatment arms (telmisartan and terazosin) and one shared placebo. Additional arms are expected to be launched every 12 months, the first one which will be ursodeoxycholic acid (UDCA).
- The primary outcome is the combined patient reported score of the MDS-UPDRS Part I & MDS-UPDRS Part II.

### Digital Measures Sub-study:

The DMSS will recruit participants from the EJS ACT-PD trial. Participants will wear a body worn device every 6 months for a period of seven days to measure real-life mobility over the EJS ACT-PD trial duration.

**Figure 2**: Digital mobility assessment timepoints




### Applying the digital device and DMOs obtained:

Participants will be provided with a digital device for their first DMO data collection and trained in its application.

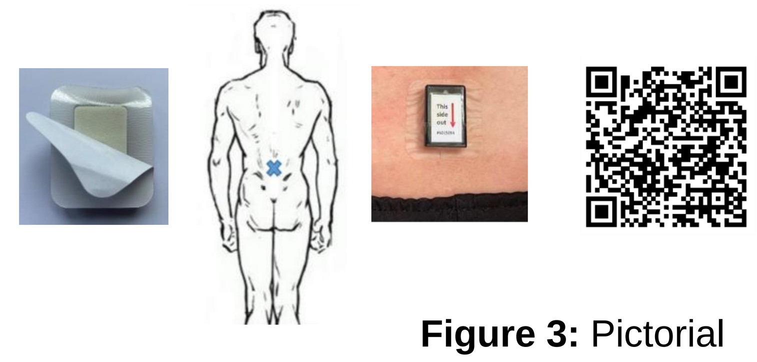


**Figure 3:** Pictorial representation of device placement and accessories, plus link to video with instructions on how to attach and remove the device

**Table 1**: Technically validated DMOs that will be extracted

| | |
|---|---|
| **Walking activity** | |
| **Amount** | Walking duration [hours/day] |
| | Walking bout (WB) Step Count [number/day] |
| **Pattern** | Number of daily WBs [number/day] |
| | Number of daily WBs longer than 10seconds (s) [number/day] |
| | Number of daily WBs longer than 30s [number/day] |
| | Number of daily WBs longer than 60s [number/day] |
| | WB duration [s] |
| | P90 WB duration [s] |
| | WB duration bout to bout variability [%] |
| **Gait** | |
| **Pace** | Walking speed in shorter (10-30s) WBs [m/s] |
| | Walking speed in longer (>30s) WB [m/s] |
| | P90 walking speed in WB>10 s [m/s] |
| | P90 walking speed in longer (>30s) WB [m/s] |
| | Stride length in shorter (10-30s) WB [cm] |
| | Stride length in longer (>30s) WB [cm] |
| **Rhythm** | Cadence in all WB [steps/minute] |
| | Cadence in longer (>30s) WB [steps/min] |
| | P90 cadence in longer (>30s) WB [steps/min] |
| | Stride duration in all WB [s] |
| | Stride duration in longer (>30s) WB [s] |
| **Bout to bout variability** | Walking speed bout to bout variability in longer (>30s) WB [%] |
| | Stride length bout to bout variability in longer (>30s) WB [%] |
| | Cadence bout to bout variability [%] |
| | Stride duration bout to bout variability [%] |

## Results:

- To evaluate the potential of DMOs as digital trial endpoints, analyses will include DMO correlation with and predictive of the main trial outcomes, in addition to longitudinal change of DMOs.
- The study will also assess adherence, data completeness, and acceptability, informing the feasibility of remotely deploying DMOs in large MAMS trials.
- Demographic comparisons between those who consent to the digital measures study and the main trial cohort will identify any participation biases.

## Conclusions:

Embedding the DMSS within the EJS ACT-PD trial allows evaluation of DMOS in a large PD population. The findings will support the development and validation of DMOs as digital biomarkers, helping accelerate early Go/No-Go decisions and paving the way for regulatory qualification. This has the potential to speed up the evaluation of therapies and ultimately improve outcomes for people with PD.

## References:

1 Mico-Amigo ME et al. Assessing real-world gait with digital technology? Validation, insights and recommendations from the Mobilise-D consortium. *J Neuroeng Rehabil* 2023; 20: 78. 2 Mazza C et al. Technical validation of real-world monitoring of gait: a multicentric observational study. *BMJ Open* 2021; 11: e050785. 3 Delgado-Ortiz L et al. Listening to the patients' voice: a conceptual framework of the walking experience. *Age and Ageing* 2023; 52. DOI: ARTN afac233. 4 Mikolaizak AS et al. Connecting real-world digital mobility assessment to clinical outcomes for regulatory and clinical endorsement – the Mobilise-D study protocol. *PLoS ONE* 2022. DOI: 10.1371/journal.pone.0269615.

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