

RADAR

AD

Remote Assessment of Disease and Relapse – Alzheimer's Disease (RADAR-AD)

Dag Aarland

Institute of Psychiatry, Psychology & Neuroscience, King's College London, UK

Stavanger University Hospital, Stavanger, Norway

RADAR

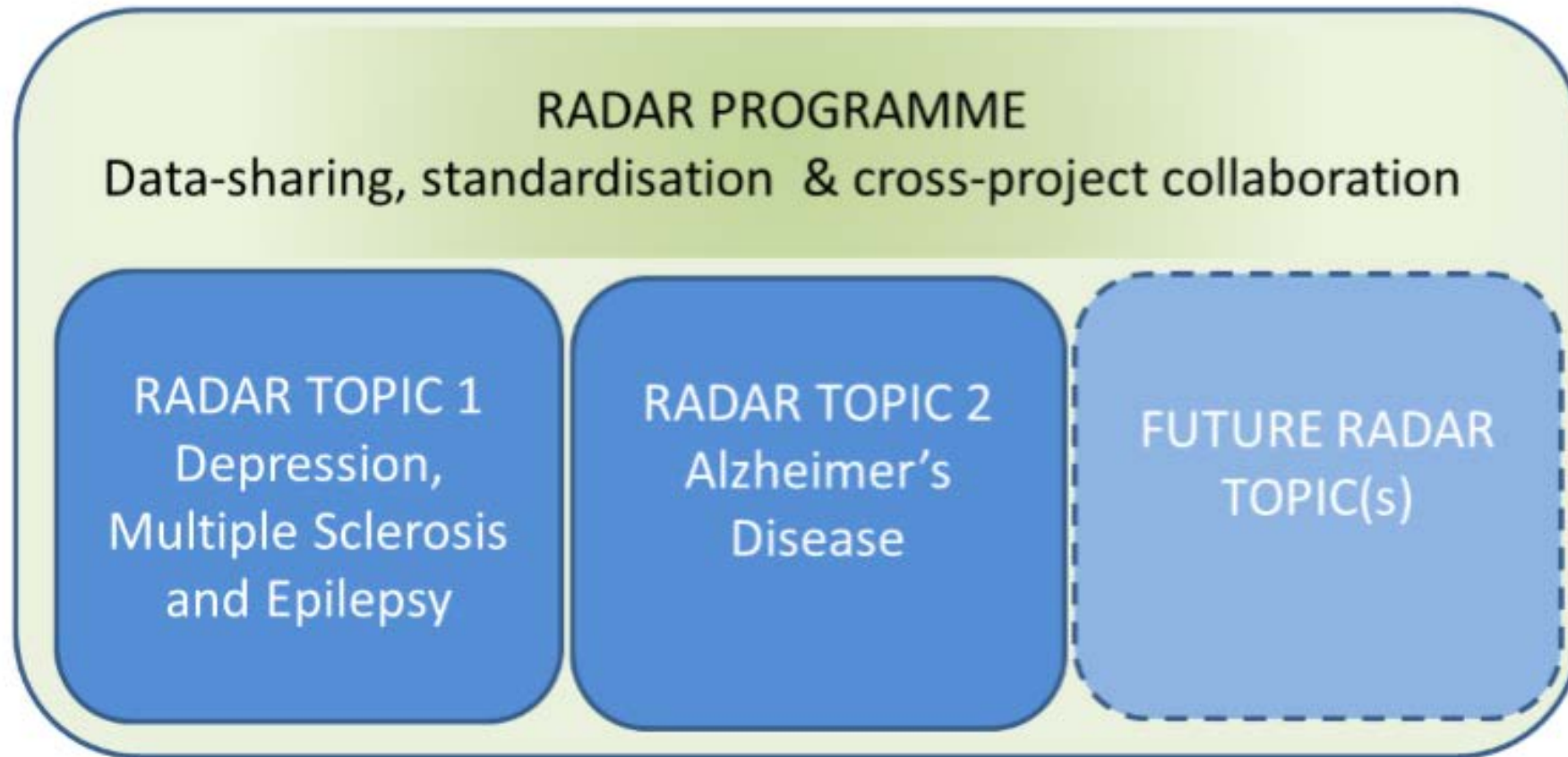
AD

IMI2: 12th Call

TOPIC 1 : DEVELOPMENT AND VALIDATION OF TECHNOLOGY ENABLED, QUANTITATIVE AND SENSITIVE MEASURES OF FUNCTIONAL DECLINE IN PEOPLE WITH EARLY STAGE ALZHEIMER'S DISEASE (RADAR-AD)

Kick-off: Jan 30, 2019

RADAR: Remote Assessment of Disease and Relapse:



RADAR

AD

RADAR IMI2 aims to overcome three **key bottlenecks** in developing methods to measure physiological and activity-based parameters remotely and continuously

- 1) a lack of fundamental disease understanding into the **signals** and fluctuations in disease state
- 2) the lack of clear **policy, guidelines** and **pathways** to develop and license 'pre-emptive' therapeutic strategies that use such digital monitoring and remote assessment technology
- 3) the **immaturity of the technology platforms**, including sensor technology, data exchange standards, continuous sensor data access and stream processing technology, as well as the analytical methodology

RADAR-AD: Need and opportunity for public-private collaborative research

- The ability to accurately track and measure **functional decline** in AD cohorts to shorten clinical development and generate payer-relevant evidence of real world impact of therapeutic interventions

RADAR

AD

The RADAR-AD Consortium

Name	Country	Type
King's College London	United Kingdom	Public
Lygature	The Netherlands	NFP NGO
VU University Medical Centre	The Netherlands	Public
The Hyve	The Netherlands	Private
University of Oxford	United Kingdom	Public
Karolinska Institutet	Sweden	Public
College ter Beoordeling van Geneesmiddelen	The Netherlands	Regulator
Fraunhofer Institute for Algorithms and Scientific Computing	Germany	Public
Alzheimer Europe	Luxemburg	Patient Organization
Janssen Pharmaceutica NV	Belgium	EFPIA
Takeda Development Centre Europe Ltd	United Kingdom	EFPIA
Novartis Pharma AG	Switzerland	EFPIA
Eli Lilly	United Kingdom	EFPIA
Software AG	Germany	EFPIA
Centre for Research and Technology Hellas	Greece	Public
Altoida AG	Switzerland	Private

Objective

Development and validation of technology-enabled, quantitative and sensitive measures of functional decline in people with early stage AD.

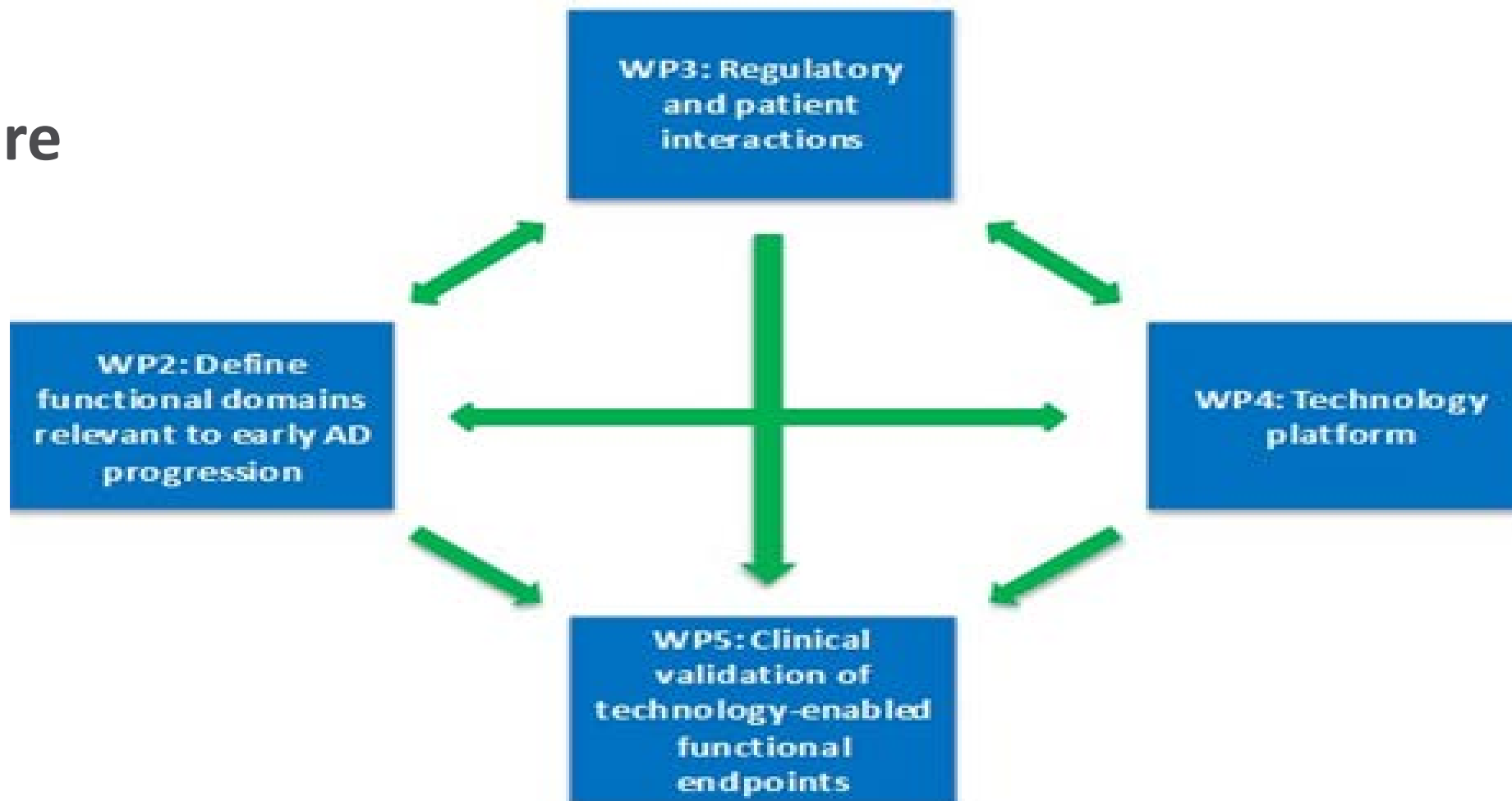
To achieve this we will:

- **Prioritize functional domains** most sensitive to early AD and amenable for devices via analysis and modeling of existing datasets
- **Select and modify the most relevant devices** that can sensitively measure functional domains most relevant in people with early AD.
- Link the project to and build on experience obtained in the RADAR-CNS project, and use and expand the open-source version of its technology platform (**RADAR-base**)
- **Validate** the technology enabled digital endpoint of function in a cross-sectional multicentre observational **clinical study** in individuals across the AD spectrum.

All this will be done in close collaboration with patient organizations and regulators.

WP1: Project Management, coordination and sustainability

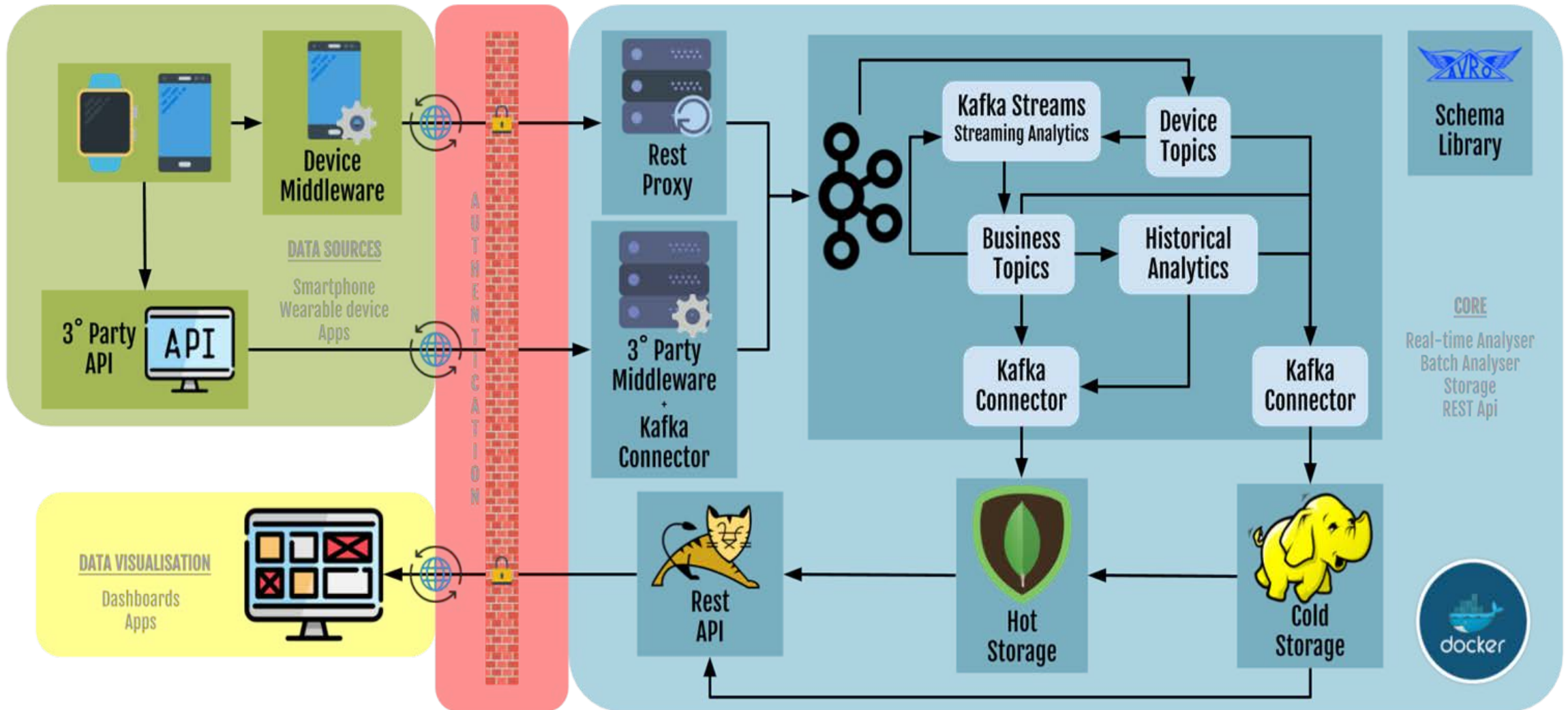
Architecture



WP6: Communication and Dissemination

1. Build a data collection, management, modelling and visualisation infrastructure. Including:
 - Generic RMT platform for active and passive RMT (aRMT/pRMT)
 - Data management pipeline, processing and analysis to identify bio-signatures
 - Data visualisation platform presenting user-friendly data for patients and clinicians.
 - Maximal interoperability with health systems e.g. electronic health records (EHRs) and patient health records.
 - Acceptable privacy protections to maximise patient confidence and acceptability.





Device

Ingestion + sorting

Processing

Storage

Access

- Cognition (reaction time, typing accuracy, verbal memory)
- Mood (self rated)
- Movement (accelerometer, GPS, Heart rate)
- Circadian rhythms (accelerometer, ambient light, self report)
- Sociability (self report, phone use, GPS)
- Speech (content, fluency, acoustic features, emotion recognition)
- Stress (life events and hassles, smartphone use behaviour)
- Sleep





Reading and Writing	Changes to reading speed, accuracy and understandability of pronunciation.	A mobile phone app or device on computer Eye motor tracking (reading), written output	Active/passive
Social interaction / Interpersonal functioning	Changes in number of outgoing calls, text messages or in number of contacts that are being	Mobile/social media. Monitoring communication and social interaction from/with phone	Passive
Motivation, signs of apathy or withdrawal	More / less phone calls and text messages	Speech output, mobility/activity monitor	Active/passive
Managing finances (e.g. writing checks, online banking, tax records)	Speed of resolving calculation exercises, speed of fulfilling 'procedure' (i.e. filling out	Mobile Phone app /gamified performance tasks, simulating internet banking / letting process calculation exercises	Active
Navigating (e.g. traveling to a destination outside of neighborhood either by car, bus,	Navigation app and GPS sensor and timing readout upon getting a 'navigation exercise' to complete	GPS signal, wifi signal, accelerometer signal Mobile Phone App, Simulation/virtual reality/gamification	Passive Active
Organizing self-care			Difficult to track with device?
Household management (e.g. preparing making coffee and cooking a meal in logical order,	Speed and accuracy of daily routine and deviations (slow / different procedure).	Smart Home sensors (e.g. intelligent wall plugs, low-range radar combined with layout of flat to know where appliance and	Passive
Running errands or shopping for clothes, household necessities	Performance on gamified/virtual reality tests.	Gamified/virtual reality performance assessment See above on navigating to unknown territory	
Planning skills required for task completion	Performance on gamified/virtual reality tests.	Gamified performance assessment See above on navigating to unknown territory	Active
Using memory in the process of task completion	Performance on gamified/virtual reality tests.	Gamified performance assessment, mobile app	Active
Keeping track of current events, remembering appointments,	Readout of sensors and event tracking.	Electronic sensor on medication box, tracking of missed appointments/events	Passive
Remembering an event or something that was discussed	Accuracy of response	Mobile Phone App, asking for the meals prepared / eaten in the last days (patient diary?)	Active
Acquiring new skills (e.g. new technology)	Performance on learning/gamified/virtual reality tests.	Gamified performance assessment Mobile Phone App, learning new language	Active

Understanding the plot of TV shows, books, news, conversations	Quiz performance on content (right/wrong) of movies / reports / news Performance on gamified/virtual reality tests.	Mobile Phone App, offering specific movies / reports / news Gamified performance assessment.	Active
Conversational skills	Response speed and quality	Mobile Phone App, offering a bot-like artificial intelligence for a conversation (could be a chat bot, in writing)	Active/passive
Dysnomia, word finding difficulties	Readout from speech and voice analysis	Mobile phone voice recording of spontaneous and generated speech	Active/passive
Maintaining social roles	Ability to take social responsibility, understand social rules, understanding social interactions	Mobile phone use Gamification	Passive Active
Difficulties at work	Able to function at work, not reported as failing by colleagues/supervisors		
Difficulties driving	Driving performance composite	Tracking device/sensors in cars to estimate use of breaks, distance to other cars etc.	Passive
Changes in circadian rhythm	Activity levels during day/night time and sleep	Mobile phone app, actigraph, phone readout interaction at night. Wearable sleep assessment.	Passive
Sleep quality at night	Activity levels during night time, total sleep time and sleep efficiency	Actigraphy, wearable sleep assessment, sleep trackers under the mattress	Passive
Daytime sleepiness	Signs of fatigue assessed by activity levels, daytime napping, eye-blinking and movements and facial expression	Actigraphy, mobile phone app or computer camera tracking eyes and facial expressions	Active/passive
Gait speed	Step count and speed	Mobile Phone app; Actigraphy, insoles	Passive
Computer use	Frequency and duration of use, variation and sophistication of use	APP	Passive
Mobile phone use	Frequency and duration of use, variation and sophistication of use	APP	Passive

Objectives

WP 4

- selecting pre-existing smartphone-based, wearable, or fixed measurement technologies which are deemed appropriate to the aims of RADAR-AD; and
- extending the functionality of the RADAR-Base open source software to meet the needs of RADAR-AD;
- developing a plug-in architecture that allows for deployment of such commercially available measurement technologies;
- Deploying and maintaining technology infrastructure to underpin the clinical study



Objectives WP5

- 1a Test criterion validity of RMTs in a clinically relevant population of 240 subjects across the clinical spectrum of AD.
- 1b Feasibility, acceptability
- 2. Monitoring technical performance of RMTs and platform during the study and implementation of improvements as appropriate
- 3. To analyse RMT data and compare outcomes against established clinical outcomes in AD
- 4. To position RMT data in the disease model developed in WP2 and provide recommendations on the use of RMTs in future trials corroborated with a regulatory advice.
- 5. Explore whether RMT can improve power statistics compared to standard ADL measures

RMT: Remote Measurement Technology



Tier 1: Wearables and mobile novel RMT procedures	240 (10 sites)	Wrist accelerometer, smartphone apps for passive data collection, including communication and active interactions (e.g., performance to tests, response to questionnaire, etc.) and other detectors to be defined.
Tier 2: Fixed sensors	50*(4 sites)	Fixed devices such as power socket monitors, movement sensors and bed-mounted sensors
Tier 3: Digital home	5* (1 site)	Multiple devices developed in the ACTIVAGE and Dem@Care projects that assess movements and the use of various home facilities (kitchen, refrigerator, bath, etc.)

- DEVELOPMENT AND VALIDATION OF TECHNOLOGY ENABLED, QUANTITATIVE AND SENSITIVE MEASURES OF FUNCTIONAL DECLINE IN PEOPLE WITH EARLY STAGE AD
- IMI Public-Private partnership
- Identifying relevant functional domains
- Select and modify the most relevant devices to measure functional domains
- Validate these devices in a clinical trial

- Kick-off 30.1.2019