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dem@care

Ageing in Place: A Multi-Sensor System for Home-Based Enablement of People with Dementia

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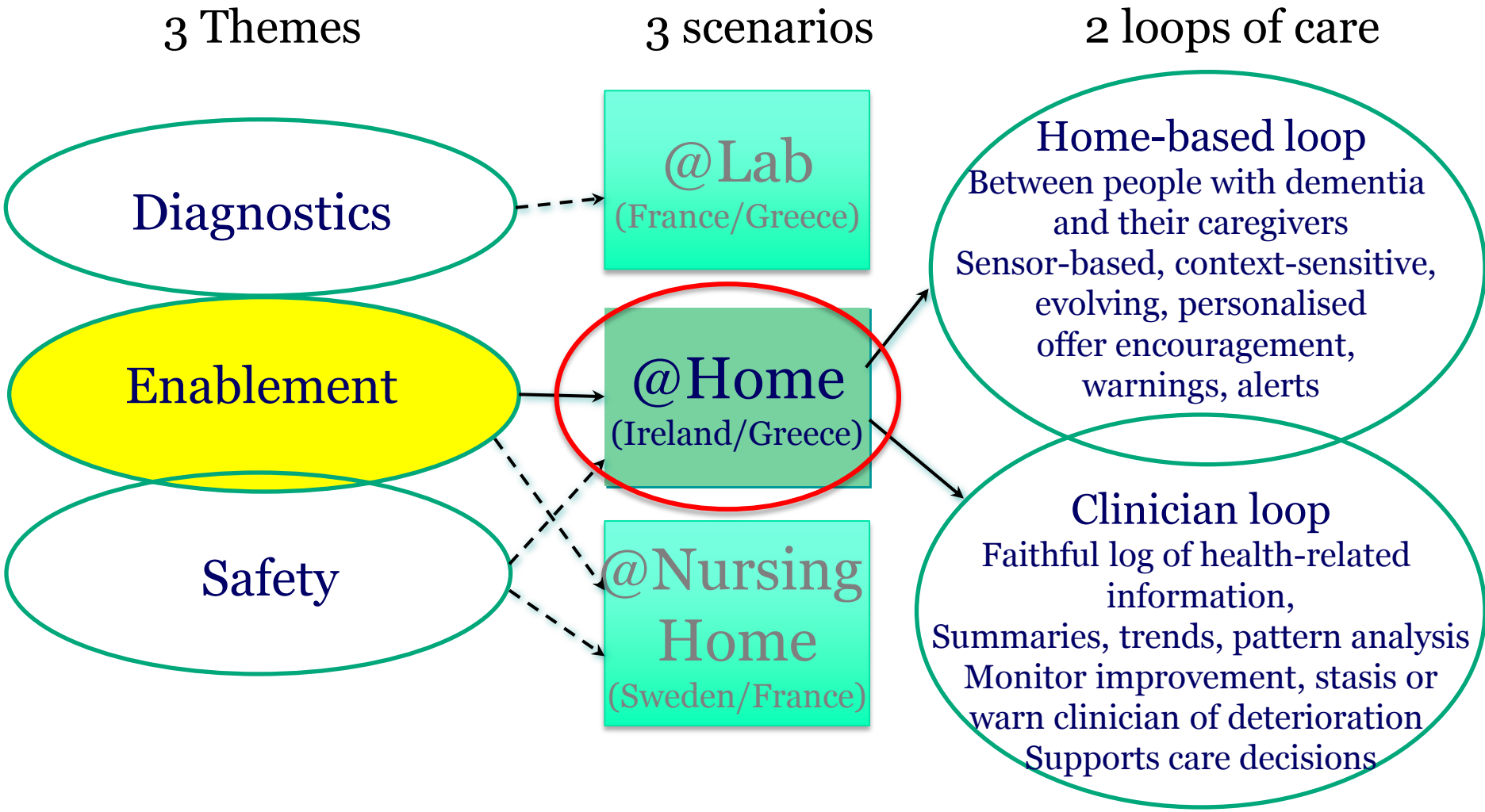
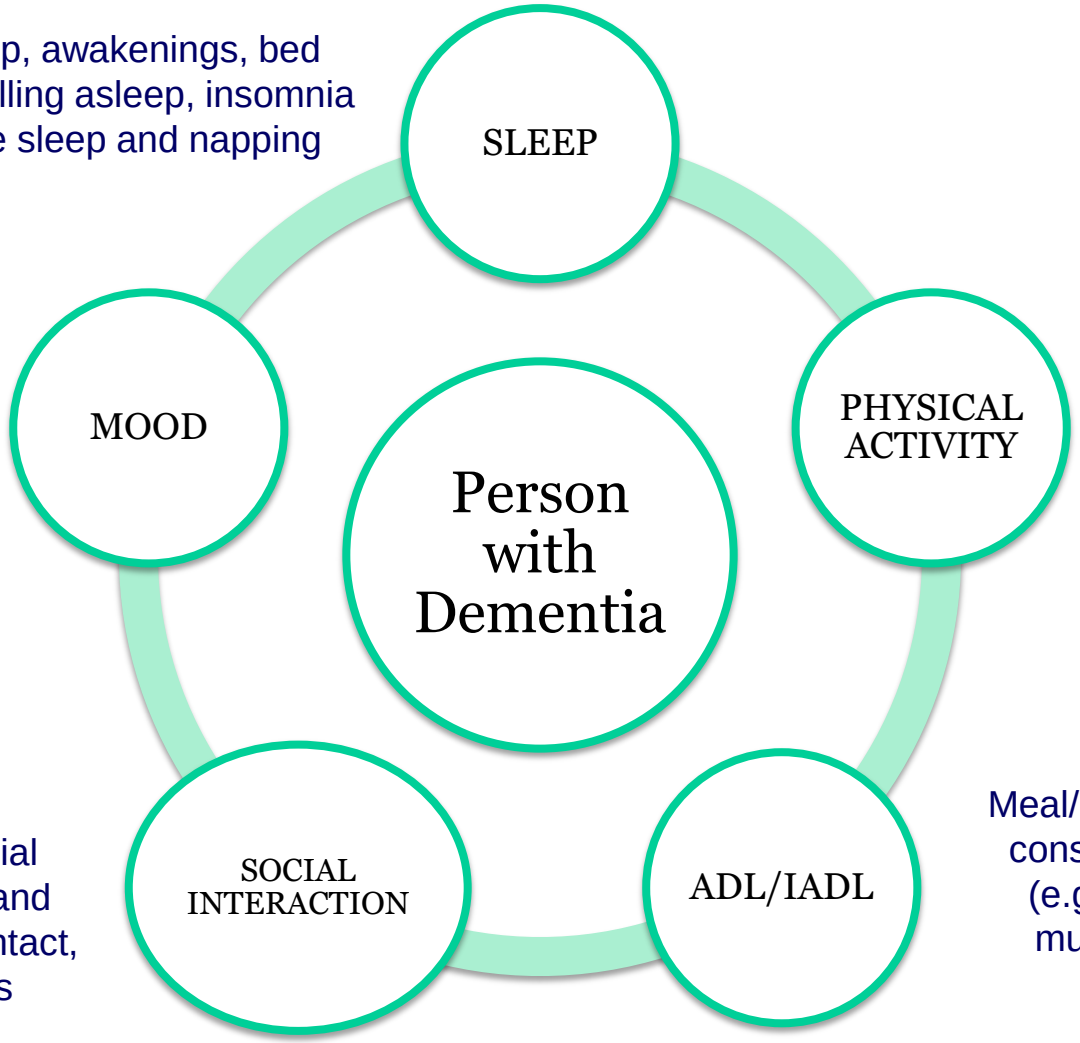
SEVENTH FRAMEWORK PROGRAMME

The Dem@Care Project



Data Collection in Five Domains



Night time sleep, awakenings, bed exits, Difficulty falling asleep, insomnia onset, day-time sleep and napping

Amount of physical activity in the home, outside the home, dedicated exercise, movement speed, distance travelled, activity intensity

Meal/Drink preparation and consumption, daily tasks (e.g. watch tv, listen to music, read, hobbies, chores)

Face-to-face social contact, initiated and received phone contact, speech analysis

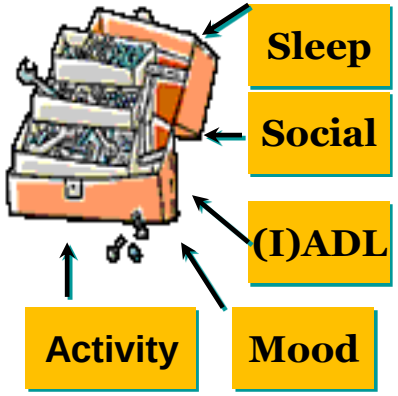
Observed behaviour, physical stress levels , speech analysis, subjective mood reporting

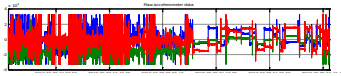
Dem@Home: Aims and Methodology

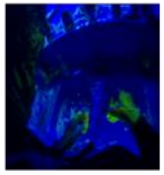
- Research Questions
  - Is the system acceptable in the home, is it non-intrusive, and useful to people with dementia and their families?
  - Can the system optimise the functional status of the person with dementia as operationalised in the 5 domains?
  - How autonomous and independent is the person with dementia and can the deployment of this system support this autonomy?

- Multiple case study design - person centred using a toolbox approach
  - Initial assessment of acceptability and usability (n=5 dyads)
  - Lead User participants (n=2 in Dublin; n=3 in Thessaloniki; 7-20 months in duration)
  - Intervention participants (n=5 in Dublin; 3-4 months in duration)

Dem@Home Sensor Toolbox

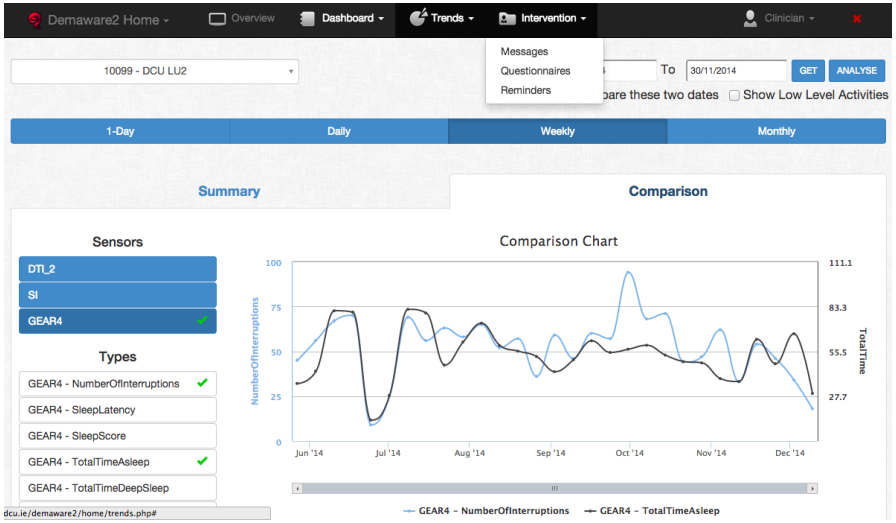




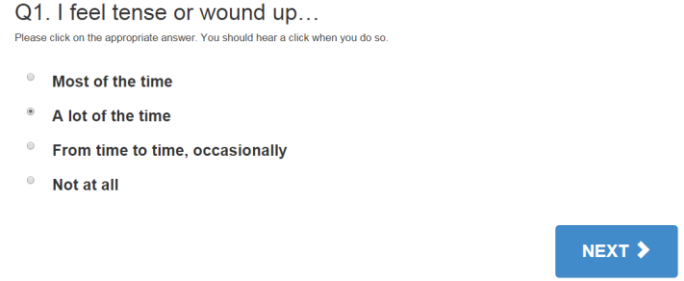


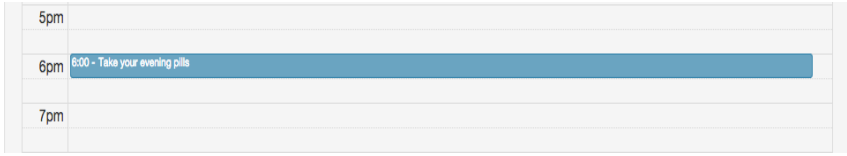
The Dem@Home System

- Clinician is able to monitor
  - Sensors recordings
  - Analysis results (e.g. completed activities) from the current or previous dates/periods



- Person with dementia and the carer are able to read messages-prompts-advice that come from
  - The System
  - Clinician





Dublin Case Study: Recruitment Protocol

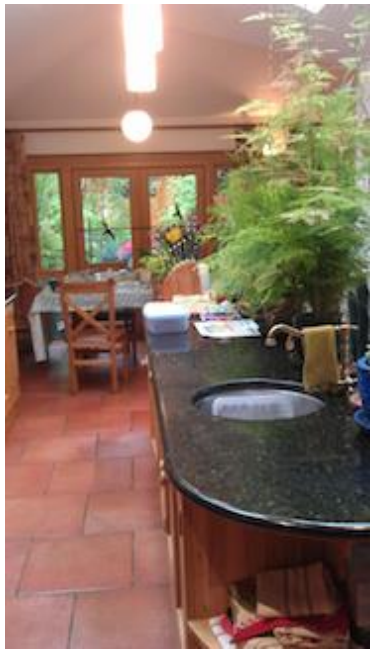
- Person living at home with early dementia - family caregiver
  - Initial semi-structured functional assessment interview
  - Lead user from October 2013 – involved in co-design process
  - Large longitudinal dataset but some data analysed retrospectively

Sleep	PSQI, Epworth Sleepiness Scale, Insomnia Severity Index, Morningness - Eveningness Questionnaire, Scale of Older Adult's Routine
Physical Activity	Rapid Assessment of Physical Activity, Physical Activity Scale for the Elderly
Eating / IADL	Bristol ADL Scale (proxy), Everyday Competence Questionnaire, Mini-Nutritional Assessment
Mood	Geriatric Depression Scale (GDS)
Social Interaction	Lubben Social Network Scale, De Jong Loneliness Scale
Other	Quality of Life (Qol-AD), Carer-Qol, HADS, RSS

Dublin Case Study: Sean and Catriona

(pseudonyms)

- Sean (Age 58) and Catriona are married and live with Sean's mother in their own home outside Dublin. They have two dogs.
- Sean was a carpenter and Catriona works 4 days a week in administration.
- At the start of the study, Sean was just post-diagnosis.
- Sean is active and independent and has comorbid epilepsy, which is being successfully managed pharmaceutically.
- Sean's mother was not aware of his diagnosis.

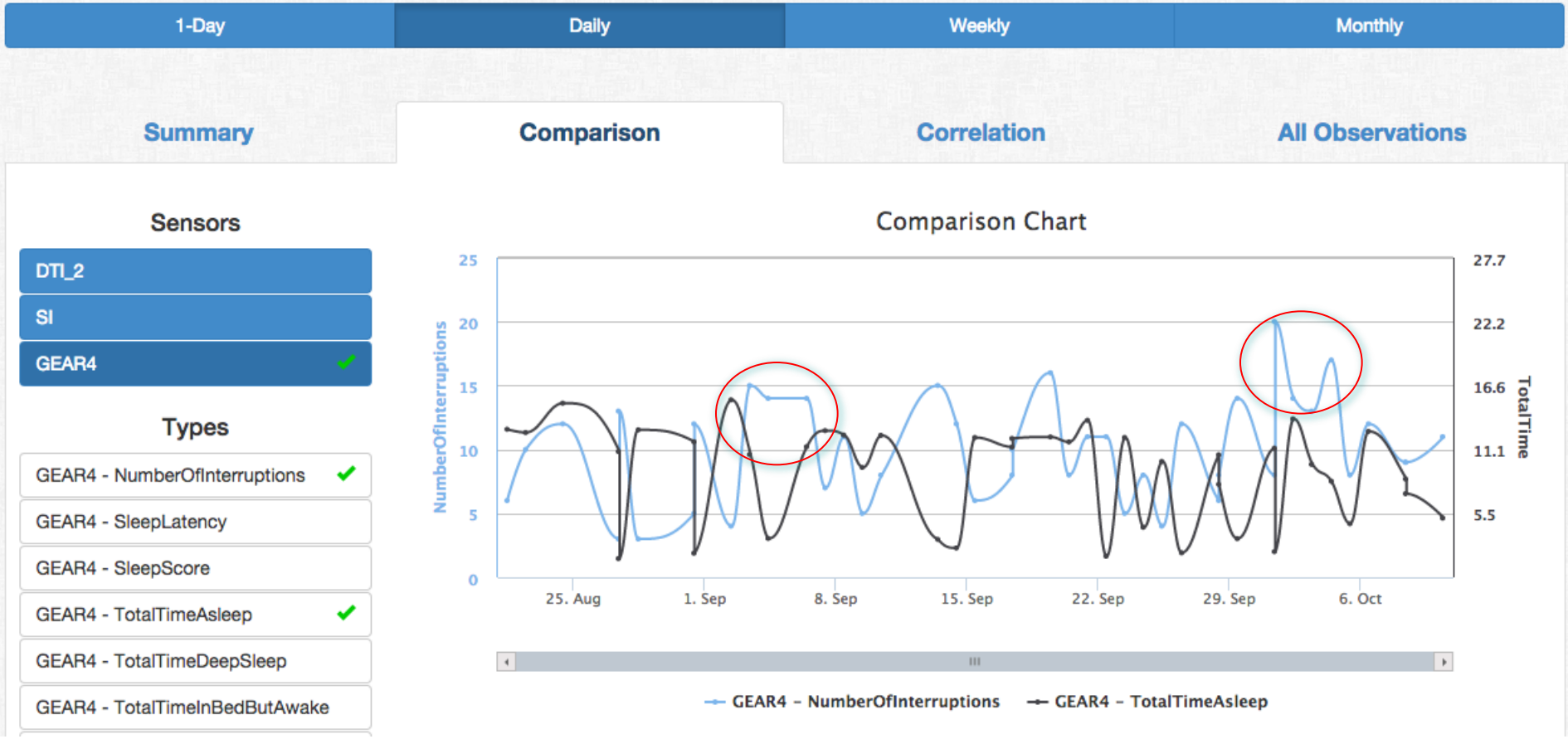


Dublin Case Study: Baseline Assessment

Domain	Needs	Sensors
Sleep	PSQI score of 6 (sleep pathology) Duration and latency good; disturbance, efficiency, overall quality poor	Gear4 Sleep Clock DTI-2 Actigraphy
ADL / IADL	General eating, cooking and chores are good, but some tasks may need support (e.g. using the CD Player)	Wearable video Ambient video
Physical activity	No issues detected, although Sean indicated interest in having support in this area	DTI-2 Actigraphy
Social Interaction	No issues detected, although both felt there may be a benefit from support in this area	Periodic psychometric measures
Mood	No issues detected	Periodic psychometric Measures
Other Measures*	Qol-AD (PwD) = 42; Qol-AD (Carer) = 34 Carer-Qol = 5; HADS (A) = 19, (D) = 12; RSS (ED) = 20, (SD) = 15. (NF) = 0	Periodic psychometric Measures

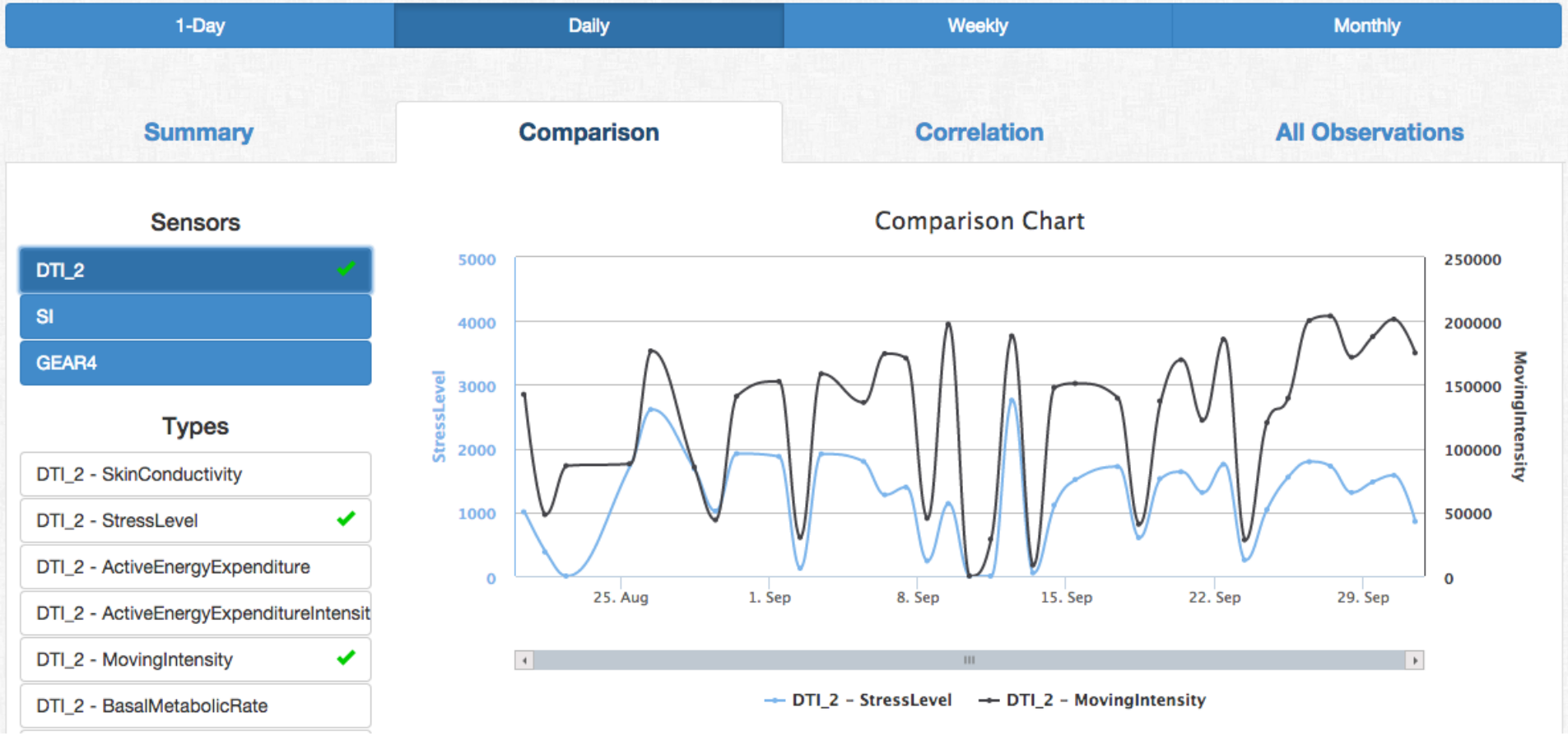
Dublin Case Study: Sleep

- 556 days deployment; 436 days of usable data
- Some disruption in sleep duration and sleep interruptions evident on a day to day basis but very stable patterns over time
- Clear periodicity – higher interruptions on week day mornings



Dublin Case Study: Physical Activity

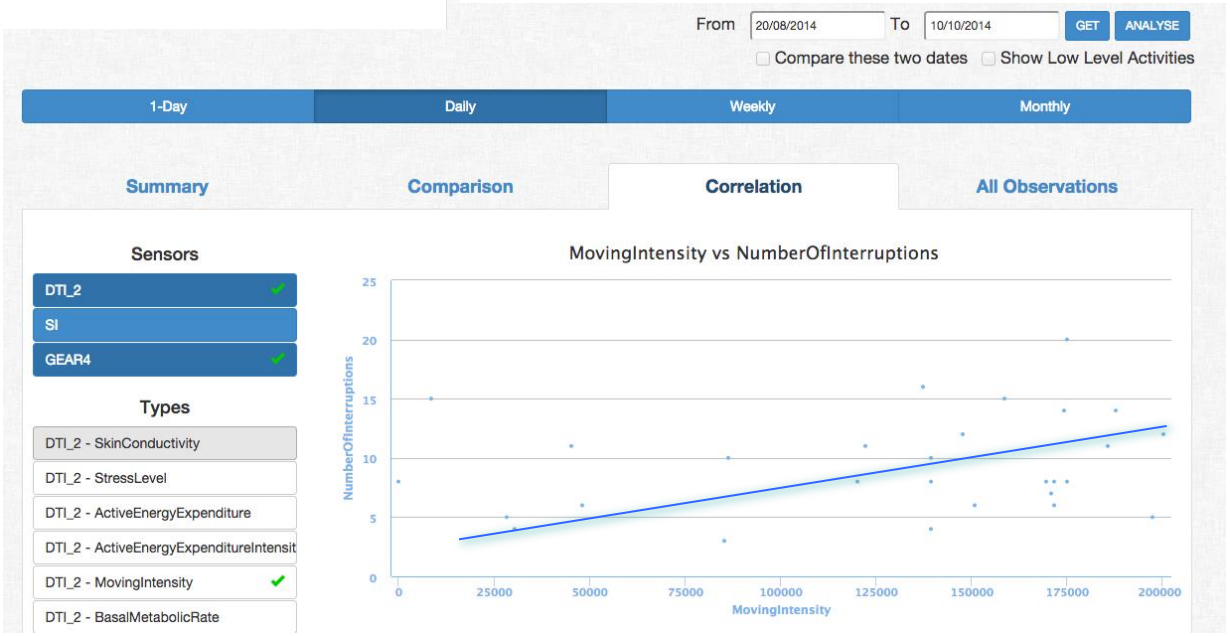
- 556 days deployment; 330 days of usable data
- Within day variation in activities (more active in the mornings)
- Stress levels generally match activity levels (some exceptions)



Comparisons and Correlations

- Compare any measure with any other (daily, weekly, monthly)
- Interactive labels allow
  - easy highlighting of one data series
  - Quick switch off/on functionality

- Correlate any two variables for any length of time (e.g. Moving intensity and sleep interruptions)
- Some improvements required



Dublin Case Study: ADL / IADL

- Most successful data capture was for activities that formed a natural part of PwD's day
  - Making breakfast, tea, watering plants, feeding birds
  - Capturing specific activities like 'playing a cd' were not successful unless they took place with researcher

- Over 130 hours of data; 4.33 were manually annotated to train location, activity, and object algorithms
  - Feed birds (95.98%), Water plant (85.5%), Talk on phone (74.7%), Prepare drug box (49.7%), Breakfast (45.6%), Meal (46.98%), prepare tea (39.1%)

- Manual observation study will be carried out this summer and results will be compared with Dem@Care

Thessaloniki Case Study - Protocol

- Person with MCI living alone at home
  - Co-morbid depression and anxiety
  - Small apartment (living room, bedroom, kitchen, office)
  - Commenced later (February 2014) – real-time intervention support

Mental State	Emotion	Functional
MMSE	BDI	Quality of Life
Verbal Fluency	Beck - Anxiety	IADL
Trail Making (Part B)	Anxiety Perception	FUCAS
TEA	Hamilton Test	FRSSD
RAVLT	GDS	CDR
ROCFT	NPI	
MOCA	Pittsburgh	

Thessaloniki Case Study: Baseline

Domain	Needs	Sensors
Sleep	Difficulties with sleep – intermediate and general insomnia, palpitations and anxiety. Also frequent and long bathroom visits.	Sleep sensor (Aura) Actigraphy (Up24) Presence sensors (bathroom)
ADL / IADL	Low levels of ADL (e.g. person doesn't vacuum, iron, wash clothes) Also monitor: cooking, washing dishes, eating, refrigerator usage, phone	Ambient video (kitchen) Presence sensor (kitchen) Plug and motion sensors (various) Water sensor (flower pot)
Physical activity	Low levels of physical activity - correlated with time watching TV. Also some gait and stability problems	Actigraphy (Up24) Plug sensor on TV Motion sensor (TV remote) Ambient video
Social Interaction	Almost no social interaction reported	Door sensor Intervention required
Mood	Low mood reported	Receiving intervention

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Thessaloniki Case Study: Interventions

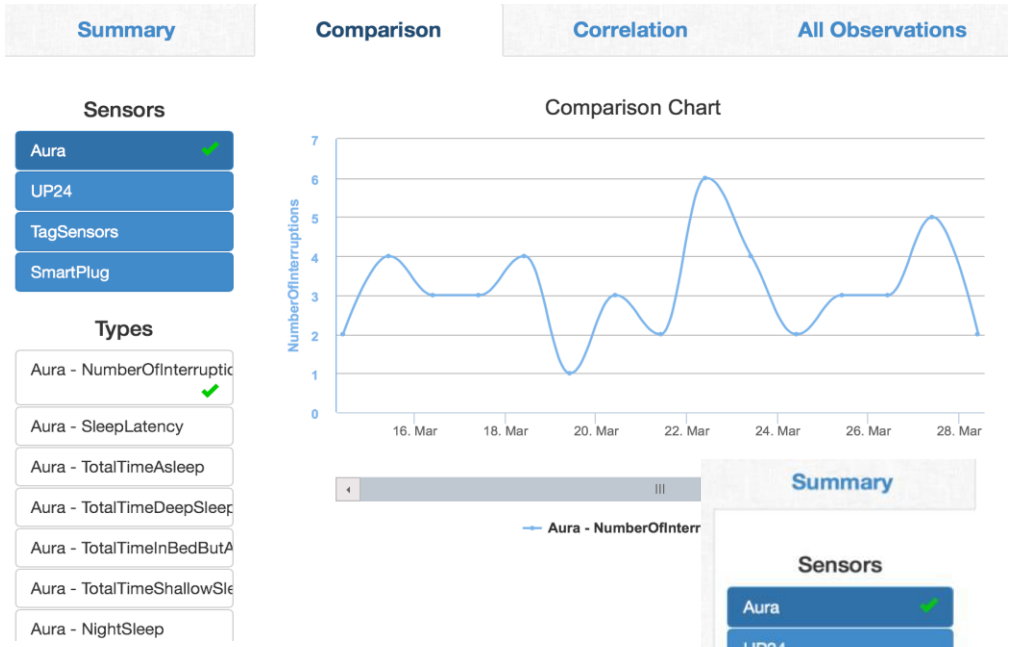
- Suggested interventions (e.g.)
  - Physical activity at home via Smart TV every two days
  - Ballroom dance therapy twice a week
  - Psychotherapy
  - Perform a schedule of simple daily living activities: cooking, bathing, washing dishes, potting flowers, maintain social life – build motivation to participate in everyday life
  - Relaxation exercises and anxiety management techniques

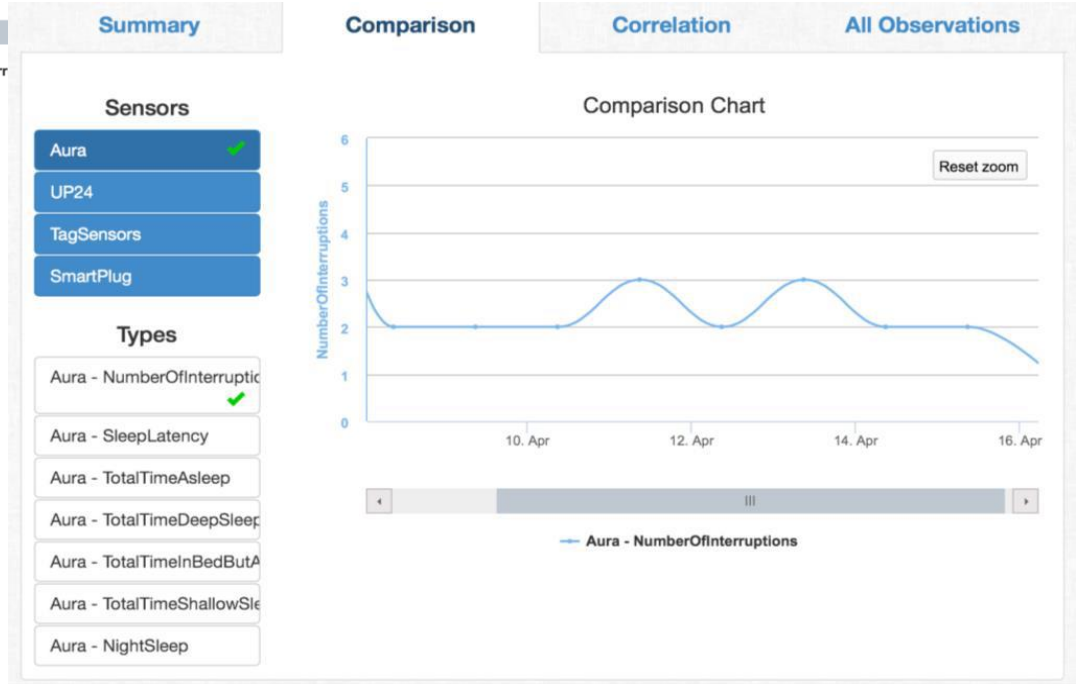
- Dem@Home and associated sensors
  - Monitor compliance
    - *Activities according to weekly schedule*
    - *Gait improvement from physical activity/dancing*
  - Enable ongoing evaluation
    - *Sleep, physical activity and ADLs*
    - *Alter intervention is desired results not being met*

Thessaloniki Case Study: Physical Activity

- ADL intervention– scheduled daily activities
- Increased levels of moving intensity found

Improvements in sleep before and after





Dem@Home: Key Strengths

- Objective measurement
  - Provides a different approach to the clinical assessment of a person's cognitive, functional, and emotional status in a familiar environment
  - Supports ongoing monitoring of improvement, stasis, or decline
- Individualisation of interventions and treatment plans
  - Gives immediate results about everyday activities
  - Improvements for person with MCI/dementia based on feedback and monitoring
    - *Sleep quality: Less TV watching lead to more sleep*
    - *Daily routine: Active participants in ADLs*
- Support the person with dementia with online reminders, checklists, prompts, directed practise

Dem@Home: Key Challenges

- Recruitment difficulties unless combined with an intervention
  - Comfort with technology and ethical concerns
  - What happens when the researcher/clinician leaves?
- Initial anxiety regarding sensor use (in some cases)
  - Importance of adequate training and researcher/clinician support
  - Need to balance the idea of co-design with the difficulties introducing an incomplete system with a person with dementia
- The suitability of deploying sensors with someone in the later stages of dementia – when is too late?
- Ethical issues
  - Informed consent and third party consent
  - Privacy – sensor privacy options forgotten, safety nets needed
  - Surveillance – risk of continuous monitoring

Conclusions

- Value of objective ongoing assessment
  - Analysis of sensor level data shows promising results although the real value of the Dem@Home system is the ability to:
    - *Triangulate data from various sensors measuring varied domains*
    - *Identify improvement, stasis, and/or deterioration over time*

- Supports that enable Dem@Home use
  - Easy to use sensors, data transfer, and automated feedback
    - *Caregiver is still required as primary source of support*
    - *Clinician needs to make the effort to ensure that people understand how ICT can and may not help, and that informed consent is given*
  - Importance of well-supported training periods
  - Importance of personal interaction with the clinician (or researcher)
  - Perceived benefits must be stronger than the perceived effort to use the technology

Dem@Home – For Further Information…

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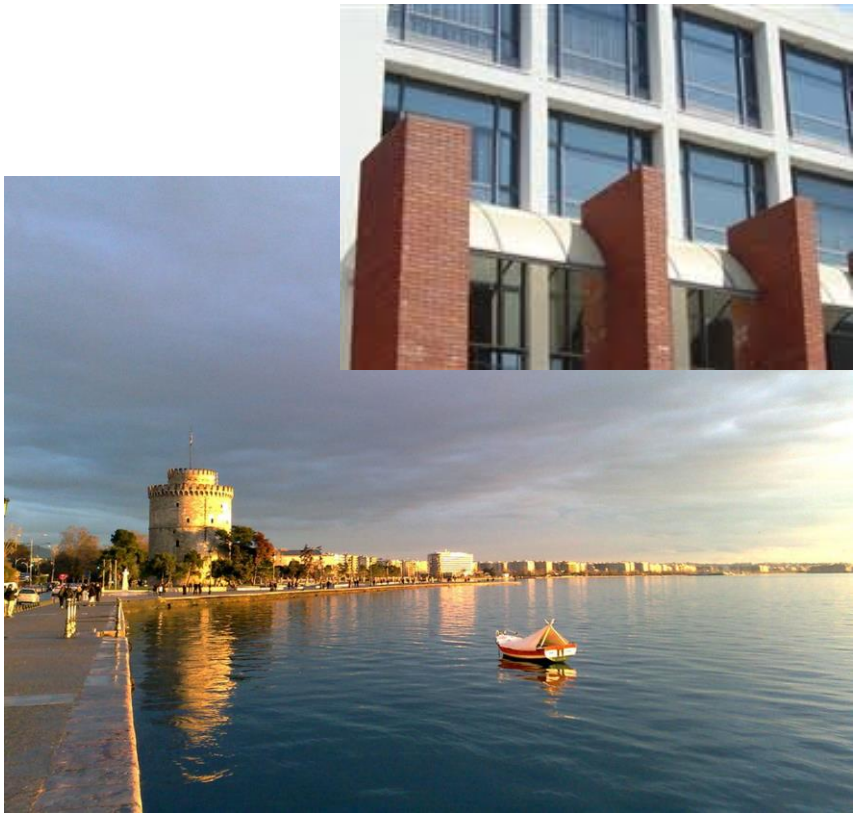

Thank you for your attention

For further information:

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