UK DRI: revolutionary in scale

1 A single national institute
3 Founding funders
6 Universities

300 today, growing to 700+
Researchers

50 today, growing to 70+
Group leaders

£290m Investment

Researching all dementias
Alzheimer’s disease, Parkinson’s disease, frontotemporal dementia, vascular dementia, Huntington’s disease, amyotrophic lateral sclerosis, dementia with Lewy Bodies, and beyond
To transform dementia care through the use of new technology

- Receiving good, person centred care (>60% of carers)
- Managing sleep, changes in sleep and wakefulness (42%)
- Communication between people involved in care (40%)
- Incontinence (39%)
- Technologies that assist people to live independently (32%)

85% would prefer to live at home for as long as possible

1 in 4 for people living with dementia

70% increase over the last 5 years
Infections
Sleep
Irritability/aggression
Treatment effects (positive and negative)
Communication
Disease progression
Wearables
Physiological Monitoring

- **Thermometer**: Every 2 days, and symptomatically
- **Urine sample**: Every 54 days, and symptomatically
- **Blood pressure**: Every day, and as required
- **Weighing scales**: Every 2 days, and as required
Environmental Sensors
UK DRI Healthy Home – Digital Platform

- Cloud Computing
- AI/Machine Learning
- Personalised Intervention
- Data Integration & Intelligent decision-making
- Encrypted home storage
- Home Monitoring
- Medication
- Behavior
- Sleep
- DataBox
- EEG
- Infection
- Robotics
- Digital Platform

Limited, Secure, Private
Technology integrated health management (TIHM) for Dementia

400 people with dementia and their carers

21 devices deployed in the home

Machine learning to generate clinical alerts e.g. UTI/agitation

Clinical monitoring team to respond

Participants feel more supported and safer
Urinary Tract Infection (UTI) risk analysis

Has TIHM alerted you to any health problems?
Physiological data
Environmental data – movement at home
Environmental data – movement at home
Semi-supervised learning for UTI detection

Sensitivity 88% & Specificity 84%

Prof. Payam Barnaghi
Univ. Surrey
Urinary Tract Infection (UTI) - risk analysis

Daily representation of data
(24 hours x 8 nodes) in a case without UTI

Daily representation of data
(24 hours x 8 nodes) in a case with UTI
Integrated View

Mr Sev Skillman
Univ. Surrey
# Point-of-Care Diagnostics: Synthetic Biology

## Conventional Approach

<table>
<thead>
<tr>
<th>Method</th>
<th>Dipstick Test</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>&lt; 5 Minutes</td>
<td>1-2 Days</td>
</tr>
<tr>
<td>Cost</td>
<td>&lt; £1</td>
<td>&lt; £5</td>
</tr>
<tr>
<td>Methodology</td>
<td>Chemistry</td>
<td>Microbiology</td>
</tr>
<tr>
<td>Output</td>
<td>Leukocytes and Nitrites</td>
<td>Species Identification &amp; Antibiotic Susceptibility</td>
</tr>
</tbody>
</table>

**Figure**: Comparative analysis of Dipstick Test and Culture methods for point-of-care diagnostics. Dipstick Test is faster and cheaper, but Culture is more accurate.

**Speaker**: Prof. Paul Freemont

**Institution**: Imperial College London
Point-of-Care Diagnostics: Synthetic Biology

UTI Pathogen DNA Target Sequence → Isothermal Amplification → T7 RNA Transcription → Collateral Cleavage → CRISPR-Cas Detection → Cas Protein → Transcribed RNA → CRISPR RNA → Fluorescent Reporter → Fluorescent Output
Environmental data – movement
Directly measuring behavior

Ground truth

Body Sensor Suit reconstruction

RGBD camera reconstruction

Dr Aldo Faisal
BioEngineering, ICL
Ultrawideband Radar-on-Chip

Dr Tim Constandinou
Electrical Engineering, ICL
Video-based automatic analysis of sleep in dementia

Integrate passive sensors for contactless multi-modal sleep assessment

Pressure bed sensors

Radar technology
Sleep – validating devices

- Bedsheet sensor – Withings
- Bed sensors – MinebeaMitsumi
- AX3 – Axivity
- Actiwatch Spectrum – Philips
- Actiwatch AWL – Camntech
- E4 – Empatica

- Move ECG – Withings
- LYS Button – LYS
- The Surrey light sensor
- Dreem EEG Headband – Dreem
- Ear-EEG – Imperial College
- Radar Sleep Sensor – Circadia
- SOMNO-HD – SMED
An intelligent & responsive environment

Voice control & Conversation

Environmental control

Social Robotics

Dr Ravi Vaidyanathan
Understanding the progression of neurodegeneration

Causes of heterogeneity

- Tau variability
- Genetic variability
- Variable inflammatory response

Environmental factors

- Chronic infection/colonization (urinary microbiome)
- Sleep
- Cardiovascular

- Traumatic brain injury
Patient-centred exploration of design and ethical issues

Dr Lenny Naar
Helix, ICL

Sarah Daniels
Brain Sciences, ICL
Aims

- Technology validated for dementia that helps support and empower
- Clinical trials – innovative designs
- Research Partnership & Data Sharing
DRI Care Research & Technology Centre
Thank you

Please contact
david.sharp@imperial.ac.uk
Hearables for Biosensing