THE ICA INTEGRATED COGNITIVE ASSESSMENT

TACKLING DEMENTIA WHEN IT COUNTS
INTRODUCTION
WHO WE ARE
CURRENT ISSUES
THE ICA
BENEFITS
COMPLETED TRIALS
MILESTONES
COMMERCIALIZATION
DEMENTIA is the biggest healthcare challenge of the 21st century

According to the World Health Organization

Costing the world US$500 Billion annually¹

Early diagnosis of dementia has the potential to save US$118,000 per patient in the US and healthcare systems have allocated budget for this

The early and proactive screening of dementia was a global market of US$2.5 Billion in 2015 and is estimated at US$7.5 Billion in 2020

There remains a major unmet need for an effective and accessible assessment solution
OUR MANAGEMENT TEAM

Born out of Cambridge, we are proud that our team has grown to include...

**DR. SINA HABIBI**
Co-founder, CEO
PhD in Engineering, nano-bio-technology, University of Cambridge. Chair of Cambridge University Entrepreneurs. Executive management in digital health and gaming. Experienced in mathematical modelling and big data consultancy. Set up medical device and pharmaceutical distribution and sales companies.

**DR. SEYED RAZAVI**
Co-founder, CSO
PhD in neuroscience, University of Cambridge
Post-doctoral researcher at MIT studying the human brain in health and disease using the combination of multimodal neuroimaging techniques and computational modeling. Extensive experience in Artificial Intelligence (AI) and machine learning applications.

**DR. THOMAS SAWYER**
Chief Operating Officer
MBA from the University of Cambridge, PhD from University of Glasgow.
13 years of experience in setting up companies, executive consulting and private equity investment in sectors including biotechnology (Alzheimer’s drug development), IT, logistics and natural resources across the globe. Guest lecturer in Finance at Cambridge, Exeter and UCL.

**DR. CHRIS KALAFATIS**
Chief Medical Officer
Consultant in Old Age Psychiatry at Maudsley Hospital in South London, lectures at Kings College London.
Developed electronic clinics for older people and led strategic NHS partnership schemes in Dementia and has worked across different NHS trusts to modernise the practice and scope of Memory Services. Extensive experience in Artificial Intelligence (AI) and machine learning applications.

**MARK PHILLIPS**
Chairman
MSt in management, University of Cambridge.
Former GSK Senior Executive with over 30 years experience in the pharmaceutical, diagnostics and life sciences industries. Has led global teams in research and development, and in manufacturing to create new businesses, products and transform performance.
OUR RESEARCH SHOWS
That existing assessment methods suffer from...

**PRECISION LIMITATIONS**
Current assessment methods are bound by assessor bias, differences in interpretation, and a lack of sensitivity in recording patient responses.

**REQUIRES EXPERT ADMINISTRATION**
A Health Care Professional (HCP) has to administer existing tests, taking up valuable time.

**LANGUAGE DEPENDENCE**
Current assessment methods can be significantly affected by the subject's level of competence in the language the test is conducted in, leading to lack of confidence in the results.

**EDUCATION DEPENDENCE**
Generally, the higher a subject's level of education, the better they will score in knowledge and memory-based testing.

**A LEARNING EFFECT**
With existing methods, a patient can seem to be getting better, when in fact they are simply learning how to do the test.

So we developed a test **FREE FROM THOSE DRAWBACKS**, we developed the ICA...
DEVELOPED FOR APPLE iOS

Working with the NHS and EHR providers like EMIS, the ICA can be used independently, or integrate *directly into a doctor's workflow*.

**UBIQUITOUS PLATFORM**
By developing the ICA for a tablet that is common place in the market, we allow easy use with no need for specialist and often expensive equipment.

**SECURE & SAFE**
Data storage and processing conform to international best practice standards, and the entire system is HIPPA compliant with fully encrypted databases to ensure patient data security.

**CLOUD HOSTING**
Storage of user information and processing and generation of test results are carried out on our secure cloud-based servers, so we can not only seamlessly integrate with HSCN but also deliver analysis directly into EHR systems, wherever they are.
CONSTANTLY EVOLVING

Thanks to our AI engine the ICA is always learning, always improving; getting ever more sensitive and taking user attributes into account.

ADAPTABLE

Through machine learning, initially based on data from clinical trial medical diagnosis, our AI engine can be continuously updated improving its accuracy and sensitivity over time as the system collects more data, while existing methods remain static and never change.

SENSITIVITY

Our AI engine uses multinomial logistic regression to create accurate hyperplanes, enabling it to be sensitive to a new users score by comparison to learnt clusters.

ATTRIBUTE SPECIFIC

AI can take into account a user’s attributes such as sex, age, and level of education to produce relative results that are both meaningful and accurate in a way that is not possible using current testing methods.
ICA OUTLINE PROCESS

Background science: predicting the reaction time of healthy human subjects in a rapid categorization task, using natural image statistics\(^2\)

Subjects are exposed to a succession of short exposure visual stimuli and asked to react to a simple question - whether or not they saw an animal. The images used vary in their properties, and the speed and accuracy of response to these vary according to the cognitive ability of the subject.

The test takes advantage of millions of years of human evolution – the human brain’s strong reaction to animal stimuli.
ICA THEORY

Measuring reaction time is a good proxy for mental health for two reasons

1. The speed of Information transmission is slower in affected neurons

2. Fewer neurons in the hierarchy means more processing time
Activated areas of the brain…

- Motor cortex
- Frontal and Prefrontal cortex (PFC)
- Visual cortex

Writing in the scientific journal ‘Nature’, Kosik contends that…

“detecting the first disruptions to brain circuitry, and tracking the anatomical and physiological damage underlying the steady cognitive decline that is symptomatic of Alzheimer’s, will require tools that operate at the ‘mesoscopic’ scale: techniques that probe the activity of thousands or millions of networked neurons.”

REF: NATURE / Kenneth S. Kosik
06 November 2013
WITH BENEFITS TO BOTH HEALTH CARE PROVIDERS...

TIME AND COST EFFECTIVE
Test duration of 5-6mins (significantly quicker than other existing tests), while no additional hardware is required

IMPROVED SENSITIVITY AND ACCURACY
Over currently available solutions, with the capacity to quantify subtle differences in cognitive responses

“GREY AREA” DISEASE DIAGNOSIS & MONITORING
High-resolution test capability allows for the monitoring of grey area diseases such as MCI and the effects of treatment

HOME MONITOR
Available for home use due to the fact that a HCP is not required to administer the test, making it ideal for ongoing monitoring of a patient’s response to treatment regime

DIRECT REMOTE FEEDBACK
To the clinician prior to follow-up appointments as the test can be launched and results obtained through existing EHR systems
...AND RESEARCHERS

ACCU RATE
Thanks to the objective micro-monitoring of cognitive changes over time using a language, education and culturally independent measurement

INCREASING STUDY COHORT SIZES
Simplicity and accessibility enables effective mass screening

REMOVE THE LEARNING EFFECT
Increased repeatability and testing resolution due to the fact that the test cannot be learnt

POTENTIAL EARLY DISEASE STAGE PATIENT RECRUITMENT
The ICA’s design gives a level of sensitivity that is not found with other methods

AUTOMATED & REMOTE RESULT MANAGEMENT
Cloud based computerised systems allow for the automatic aggregation and correlation of data
Ahead of our upcoming 6 month long clinical trial led by Dr. Chris Kalafatis, we have conducted several studies to validate the ICA’s effectiveness...

### COMPLETED TRIALS & OTHER STUDIES

- Completed Pilot Study on 40 subjects to demonstrate proof of principle in screening for dementia. *Platform: MATLAB*
- Completed a trial on 32 aged and healthy subjects demonstrating ICA™ score correlation with age. *Platform: JavaScript (Web-based)*
- Completed exploratory ‘learning study’ on 7 healthy subjects showing that the test cannot be ‘learned’. *Platform: JavaScript (Web-based)*
- Completed an exploratory trial on over 200 subjects in 3 different categories of MCI, mild Alzheimer and healthy in order to tune parameters of the artificial intelligence algorithm and to establish correlation of the ICA test with the well-known currently used MoCA paper & pen test. *Platform: Raspberry Pi*
**PILOT STUDY SHOWS BETTER RESULTS THAN STANDARD OF CARE**
Comparison with prevalent tests currently used by specialists

<table>
<thead>
<tr>
<th>Test</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Admin time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognetivity (24 healthy, 16 MCI)</td>
<td>0.71</td>
<td>50%</td>
<td>83%</td>
<td>5-7 min</td>
<td>Initial pilot study results, results expected to increase after retraining of the AI</td>
</tr>
<tr>
<td>MMSE (83 healthy, 84 MCI)</td>
<td>0.63</td>
<td>54%</td>
<td>71%</td>
<td>40-45 min</td>
<td>-5 minutes for the MMSE-2:BV; -10-15 minutes for the MMSE-2:SV; -20 minutes for the MMSE-2:EV - 5 minutes Scoring time:</td>
</tr>
<tr>
<td>VFT (83 healthy, 84 MCI)</td>
<td>0.61</td>
<td>27%</td>
<td>95%</td>
<td>3-10 min</td>
<td>should be used in combination with other screenings for dementia; so, the overall admin time will add up</td>
</tr>
<tr>
<td>CDT (83 healthy, 84 MCI)</td>
<td>0.59</td>
<td>30%</td>
<td>88%</td>
<td>5 min or less</td>
<td>should be used in combination with other screenings for dementia; so, the overall admin time will add up</td>
</tr>
<tr>
<td>CogState (40 healthy, 20 MCI)</td>
<td>0.90</td>
<td>80%</td>
<td>95%</td>
<td>3 hours</td>
<td>administered serially four times</td>
</tr>
<tr>
<td>Cantab (NF)</td>
<td>Not Found</td>
<td>NF</td>
<td>NF</td>
<td>45 min</td>
<td>we could not find MCI/Healthy accuracy numbers for Cantab</td>
</tr>
<tr>
<td>Neurotrax (15 Healthy, 20 MCI)</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>45 min</td>
<td>area under curve (AUC): 0.89 Highest results from their ‘verbal memory test’ [Not directly comparable with accuracy]</td>
</tr>
</tbody>
</table>
### COMPARING DIFFERENT DIAGNOSIS METHODOLOGIES

Across cost, sensitivity, specificity, invasiveness

<table>
<thead>
<tr>
<th>Method</th>
<th>Low cost</th>
<th>Sensitive</th>
<th>Non-Invasive</th>
<th>Early stage</th>
<th>Specific*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cognetivity</strong> computerized test –targeting brain functionalities other than memory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Cognitive-computerized tests</strong> –based on memory</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td><strong>Cognitive tests, not computerized</strong> (e.g. questionnaires or conversation), done in a clinic</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td><strong>Biomarkers</strong> reflecting molecular neuropathology (e.g. PET Scanning, CSF test)</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Diagnosis based on brain <strong>MRI</strong>– done by a clinician’s diagnosis or software-based (IXICO)</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Specific to different types of dementia
# Achieved & Anticipated Milestones

We’ve been busy, with a lot more to come...

<table>
<thead>
<tr>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ IP covered (patents, trademarks and copy rights granted)</td>
<td>✓ Quality Management System (QMS) deployed</td>
<td>• FDA filing &amp; approval</td>
</tr>
<tr>
<td>✓ Extended market research</td>
<td>✓ Pre-submission to FDA</td>
<td>• CE filing &amp; approval</td>
</tr>
<tr>
<td>✓ Product development</td>
<td>✓ Pilot studies on other conditions (i.e. Multiple Sclerosis) launched</td>
<td>• UK revenue</td>
</tr>
<tr>
<td>✓ Development trials</td>
<td>• Development and validation trials completion</td>
<td>• Partnership with health providers and insurers</td>
</tr>
<tr>
<td>✓ iOS (iPhone / iPad) versions developed</td>
<td>• QMS ISO accreditation</td>
<td>• Marketing, sales, distribution</td>
</tr>
<tr>
<td>✓ User needs study completed</td>
<td>• Home monitor (health product) partnership deal developed</td>
<td>• Strategic alliances</td>
</tr>
</tbody>
</table>

- • Marketing, sales, distribution
- • Strategic alliances
- • Publications
- • Integration with EHR systems (initially EMIS)
# COMMERCIALIZATION

How we plan to bring the ICA to market

<table>
<thead>
<tr>
<th>Vertical markets</th>
<th>Competitive advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary health practitioners (20+ General Practitioners and Clinical Commissioning Groups have registered interest both in the US and UK)</td>
<td>Improved detection rates, simple, short, no expert required, language, culture and education independent</td>
</tr>
<tr>
<td>Hospital Groups and mental health clinics (finalizing a trial agreement with a hospital group with largest R&amp;D center for mental health in EU)</td>
<td>Improved sensitivity and specificity with AI algorithm, low cost of administration</td>
</tr>
<tr>
<td>Mental healthcare specialists</td>
<td>Outpatient compatibility, ease of use, highly repeatable</td>
</tr>
<tr>
<td>Remote and digital health providers</td>
<td>Ease of use, compatibility with different platforms</td>
</tr>
<tr>
<td>Large pharmaceutical companies with ongoing clinical trials</td>
<td>Potential earlier stage detection, increased resolution, repeatability with isolating learning effects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screening (Primary Care)</th>
<th>Revenue model</th>
<th>Development plan</th>
<th>Vertical markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software as service, Charge per test (Equipment FOC or nominal)</td>
<td>Regulatory development and application (under development)</td>
<td>Primary health practitioners</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full service diagnostic support (Secondary care)</th>
<th>Revenue model</th>
<th>Development plan</th>
<th>Vertical markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge per test and additional equipment</td>
<td>Follow on from initial regulatory application</td>
<td>Hospital Groups and mental health clinics</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post diagnosis monitoring (home care)</th>
<th>Revenue model</th>
<th>Development plan</th>
<th>Vertical markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscription</td>
<td>Peer reviewed publication based on trials</td>
<td>Mental healthcare specialists</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home health monitor</th>
<th>Revenue model</th>
<th>Development plan</th>
<th>Vertical markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensing</td>
<td>Trial and development partnership with a provider (trial design phase with a conglomerate medical device and global IT company)</td>
<td>Remote and digital health providers</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug discovery and development</th>
<th>Revenue model</th>
<th>Development plan</th>
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<td>Peer reviewed publication</td>
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FUTURE DEVELOPMENT STRATEGIES
ICA patented Visual Cognition and an AI powered platform enables multiple expansion routes…

**TBI & MS**
Extend applications to other mental health conditions e.g. TBI (Traumatic Brain Injury) and MS (Multiple Sclerosis) (multiple pilot studies underway)

**PROFESSIONAL**
Professional performance monitoring e.g. sports person, pilot etc.

**WEARABLES**
Consumer performance monitoring adjunct with wearable technologies