

# Investor Update

January 2018



Cogstate



“

We believe that **brain health is profoundly important** to quality of life and should be easier to measure.

That's why we so passionately apply our expertise, access to data and flexible technology to **simplify the measurement of cognition.**”

# Cogstate Summary



Exchange: ASX  
Ticker: CGS



Focused on **BRAIN HEALTH AND COGNITION**



- Robust and growing **CLINICAL TRIALS BUSINESS FOR MEASUREMENT OF COGNITION** - both efficacy (*e.g. Alzheimer's*) and safety (*e.g. pediatric*) endpoints; and
- FDA-approved **COMPUTER-BASED TEST, COGNIGRAM**, for testing individuals (assessment conducted in clinic/hospital or at home)

## Summary of Results



FY 2017 (FY ending June 2017) revenue of **US\$26.2m**

- Revenues of **US\$13.6m** for six months ended 31-Dec-17
- Bookings of **US\$21.6m** for six months ended 31-Dec-17
- Contracted Revenue Backlog of **US\$34.7m** at 31-Dec-17



Headquartered in **MELBOURNE, AUST** with **SIGNIFICANT US PRESENCE** (79% FTE in USA)

# Leaders In Cognitive Measurement

Digital brain health assessments and novel technology enhancements for traditional cognitive measures, all driven by science and operational expertise

## Our proven technology allow clients to measure cognition with greater fidelity

- World class scientific leadership
- Market leading digital brain health assessments
- Proprietary and commercially available technology solutions, combined with novel eLearning approach, to improve traditional (analogue) cognitive assessment in trials
- Recently launched medical device (510K cleared in the U.S.)

## We are commercialising our technology in two large and growing markets



### Clinical Trials

**Full-service outsourced solution** for optimising measurement of cognition in clinical trials for more than 70 indications



### Clinical Practice

**Tools to detect cognitive change and impairment in patients** for use in hospital, physician or domestic settings

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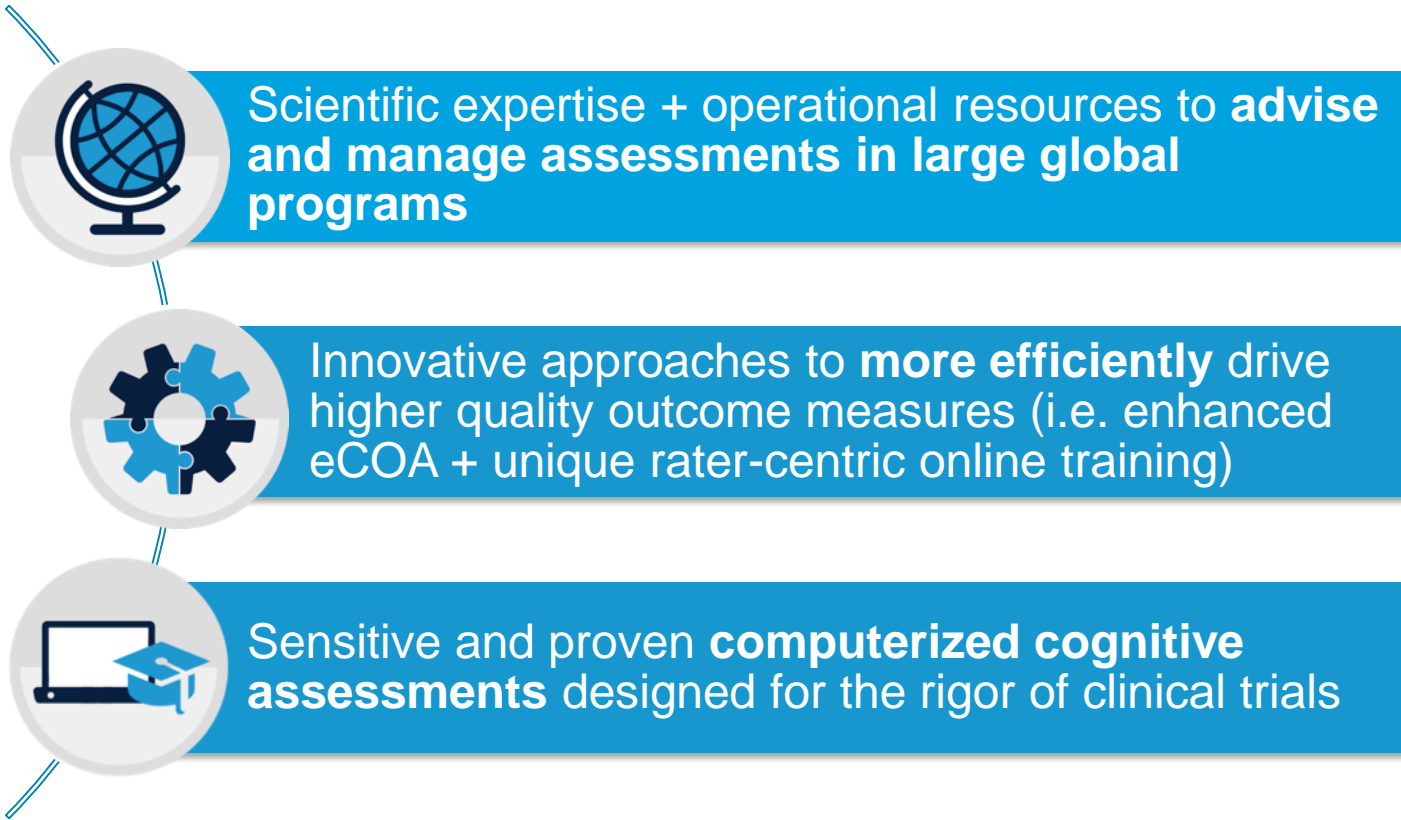
# Clinical Trials Business



# Complete Solutions for More Reliable Results



# What Sets Cogstate Apart

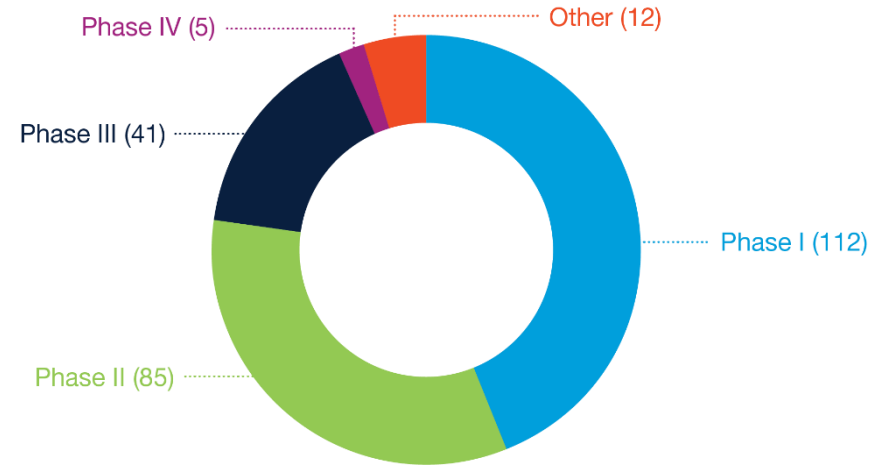




# Broad Experience Across Drug Development

## 12 APPROVALS

- Latuda (adult and pediatric)
- Opdivo
- Vyvanse
- Vesicare
- Samsca
- Brintellix
- Lyrica
- Ketanest-s
- Topamax
- Repatha
- Feraheme

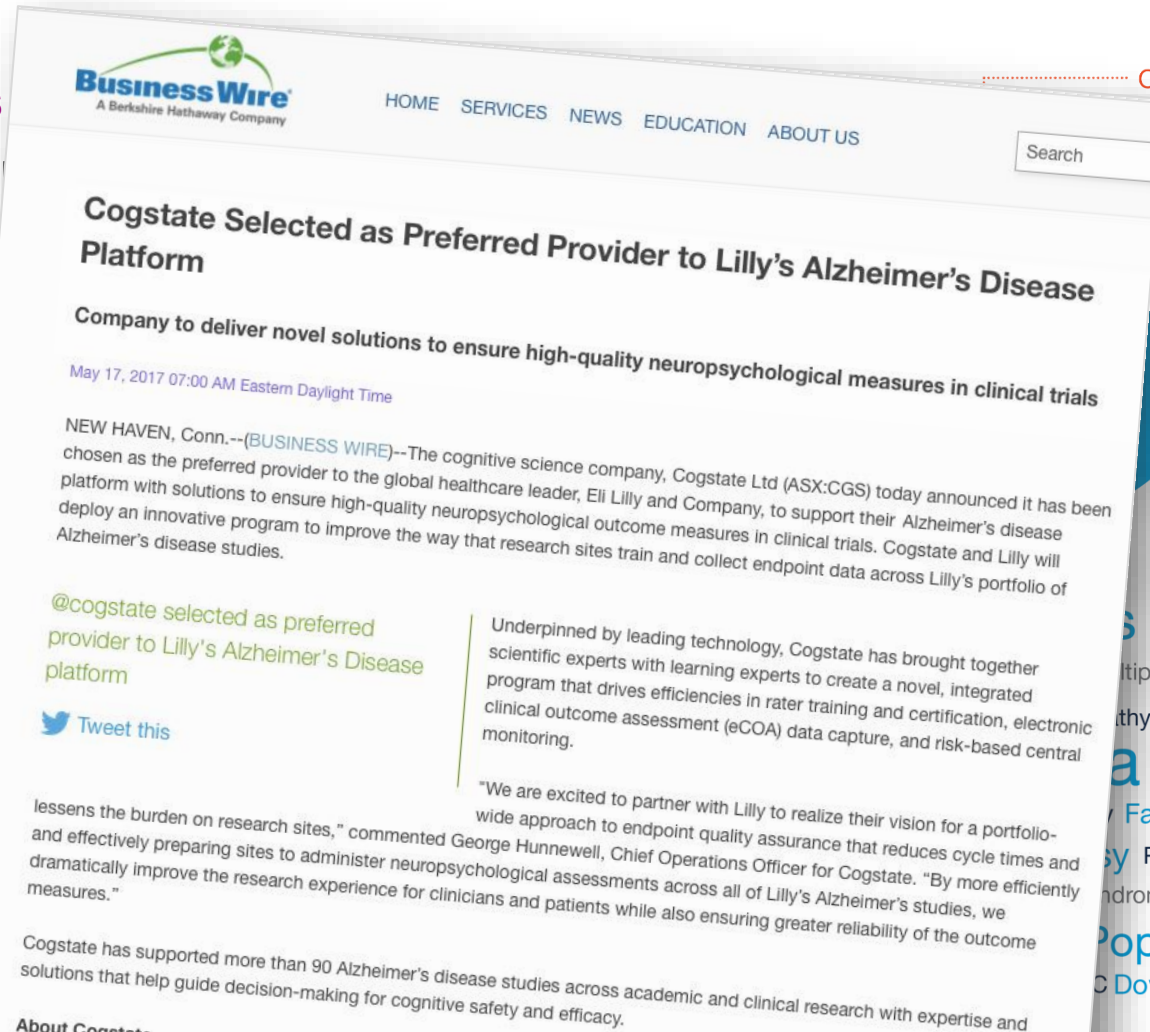


Cognition disorders **Alzheimer's disease** Heart failure  
**Major depressive disorder** Multiple sclerosis (MS) Hepatitis C  
Parkinson's disease Diabetic peripheral neuropathy **Mild cognitive impairment**  
Insomnia **Schizophrenia** Overactive bladder Stroke  
Obsessive compulsive disorder Alcohol Toxicity **Familial Hypercholesterolemia**  
Attention deficit hyperactivity disorder **Epilepsy** Prostate cancer Lung carcinoma  
Bipolar disorder **Glioblastoma** Tourette's syndrome **Paediatric Hyponatremia**  
Autism spectrum disorders **Healthy Population** Anemia **HIV**  
**Pain** Fragile X **Cardiovascular Risk** NSCLC **Down syndrome** Depression

# Broad Experience Across Drug Development

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- Lyrica
- Ketanest-
- Topamax
- Repatha
- Ferahem



Other (12)

Phase I (112)

disease Heart failure  
Multiple sclerosis (MS) Hepatitis C  
Mild cognitive impairment  
Overactive bladder Stroke  
Familial Hypercholesterolemia  
Prostate cancer Lung carcinoma  
Paediatric Hyponatremia  
Population Anemia HIV  
Down syndrome Depression

# Broad Expe

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## Global Alzheimer Platform Foundation Selects Cogstate for Industry-First Rater Certification Program

Cogstate to Support Rater Training and Certification Program to Enable Accelerated Study Start-up in Alzheimer's Disease Clinical Trials

January 24, 2018 07:55 AM Eastern Standard Time

NEW HAVEN, Conn.--(BUSINESS WIRE)--The cognitive science company, Cogstate Ltd (ASX.CGS) today announced it has been chosen by the Global Alzheimer's Platform (GAP) Foundation to support GAP's rater certification program (RCP) that will significantly increase the speed and quality of Alzheimer's clinical trials. The RCP is designed to qualify and train clinical trial site personnel to administer cognitive and functional assessments required for Alzheimer's disease (AD) studies. The RCP is central to GAP's broader mission to support its growing network (62) of high performance clinical trial sites, called GAP-Net. These sites are dedicated to increasing study quality and shortening duration of clinical trials in AD by up to two years.

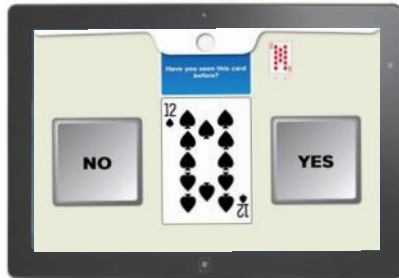
Jason Bork, Chief Operating Officer, Global Alzheimer's Platform Foundation commented, "GAP's mission is to accelerate the development of new treatments for Alzheimer's disease. We hope to eliminate redundant rater training – thereby providing a faster pathway for AD clinical trial sites to start enrolling their trials. Our partnership with Cogstate and our unprecedented rater certification program will speed the study start for AD trials and reduce trial completion delays due to rater turnover."

Cogstate CEO, Brad O'Connor, commented, "We are proud to have been selected to support such a visionary organization as the GAP Foundation which is committed to reducing the time, cost and risk of Alzheimer's clinical trials. This partnership is an important opportunity to advance the GAP mission with an innovative program that better prepares clinical trial sites to advance the research and development of AD treatments."

About Cogstate

# Enhanced Solutions Delivered in FY17

## Computerized Cognitive Assessment



Adapted our technology for more flexible, device-independent deployment models with features ideal for self assessment

## Tablet-based eSource



Partnered with Clinical Ink to provide eSource solution to improve administration and assessment when using traditional (analogue) measures of cognition

## Rater Training & Monitoring



Created a novel eLearning solution that drives efficiencies in the training, central monitoring and remediation of those administering traditional measures of cognition

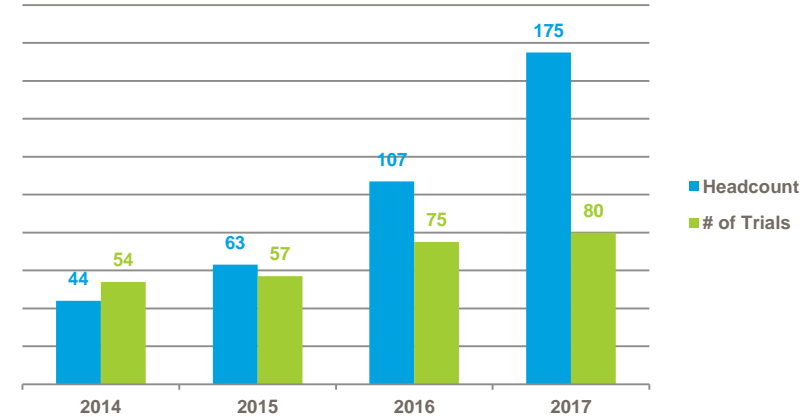
# Global Footprint and Managed Growth

## Global Footprint



- ~275 team
  - 175 full-time employees across 5 offices
  - Global network of consulting neuropsychologists (LEADS) provide local rater support to >30 countries

## Total Headcount & Active Trials



- Managed growth, hiring ahead of demand
- 40% increase from 2016 to 2017 in Clinical Trials Operations & Scientific staff (primarily in Rater Services & Project Management)
- ~80% of new clinical trials contracts are signed with repeat clients

# Clinical Trials Solution #1:

## Computerized Cognitive Testing

*technology and service solution of  
scientifically and commercially validated  
Cogstate computer based assessments*

# Cogstate COMPUTERIZED ASSESSMENT

- **DESIGNED FOR CLINICAL TRIALS & BORN IN EARLY PHASE** (high usability, acceptability to patients, no effects of language/culture)
- High **SENSITIVITY TO TRUE COGNITIVE CHANGE** in independent studies conducted by large pharma
- Success in **PHASE I-III STUDIES** as measures of safety and efficacy
- **LEADING SCIENTISTS** in effects of amyloid on cognitive function



# Full Service Solution for Computerised Assessment



## SCIENTIFIC CONSULTING

Custom batteries with expert input based on your objectives, study design and population



## TRAINING AND CERTIFICATION

Remote, study-specific site training and certification program ensures higher quality and lower inter-rater variability



## PROJECT MANAGEMENT

Dedicated project managers with science backgrounds to efficiently drive all study activities from kick-off to final report delivery



## DATA MANAGEMENT AND REVIEW

Secure online portal, DataPoint<sup>®</sup>, enables efficient data collection and storage for ongoing review of data quality by our expert data management team



## STATISTICAL ANALYSIS

Our statisticians and cognitive experts customize analysis plans with careful consideration of the study objectives, design and execution



## REGULATORY SUPPORT

Full support from the development of regulatory submissions that involve cognition to preparation and attendance meetings with regulatory authorities



# Validated Through Use in Over 1,500 Studies Across Academic and Clinical Research



>50  
Countries



>90  
Languages  
& Dialects



>70  
Indications

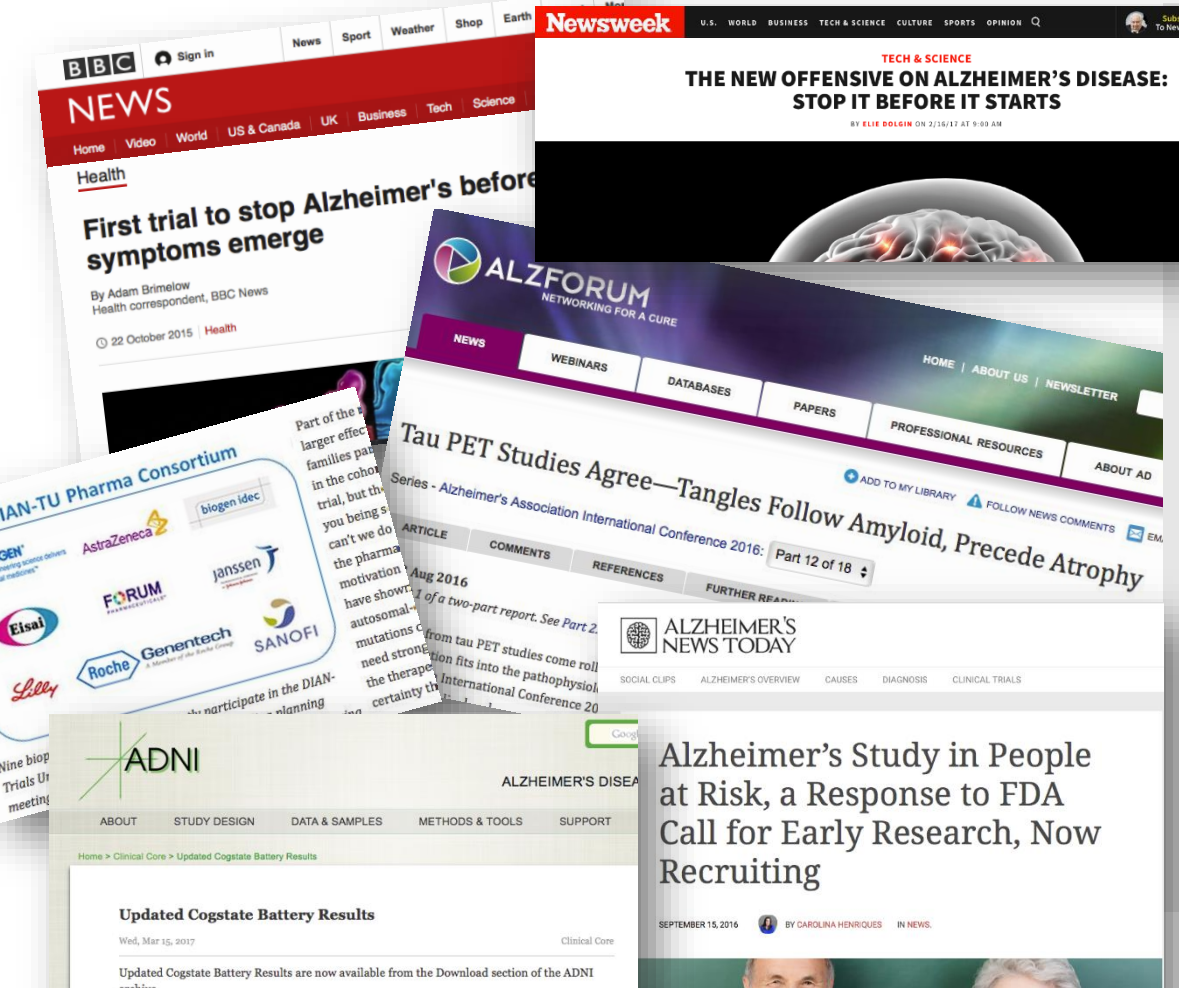


>400  
Peer Reviewed  
Publications

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**Major depressive disorder** Multiple sclerosis (MS) Hepatitis C  
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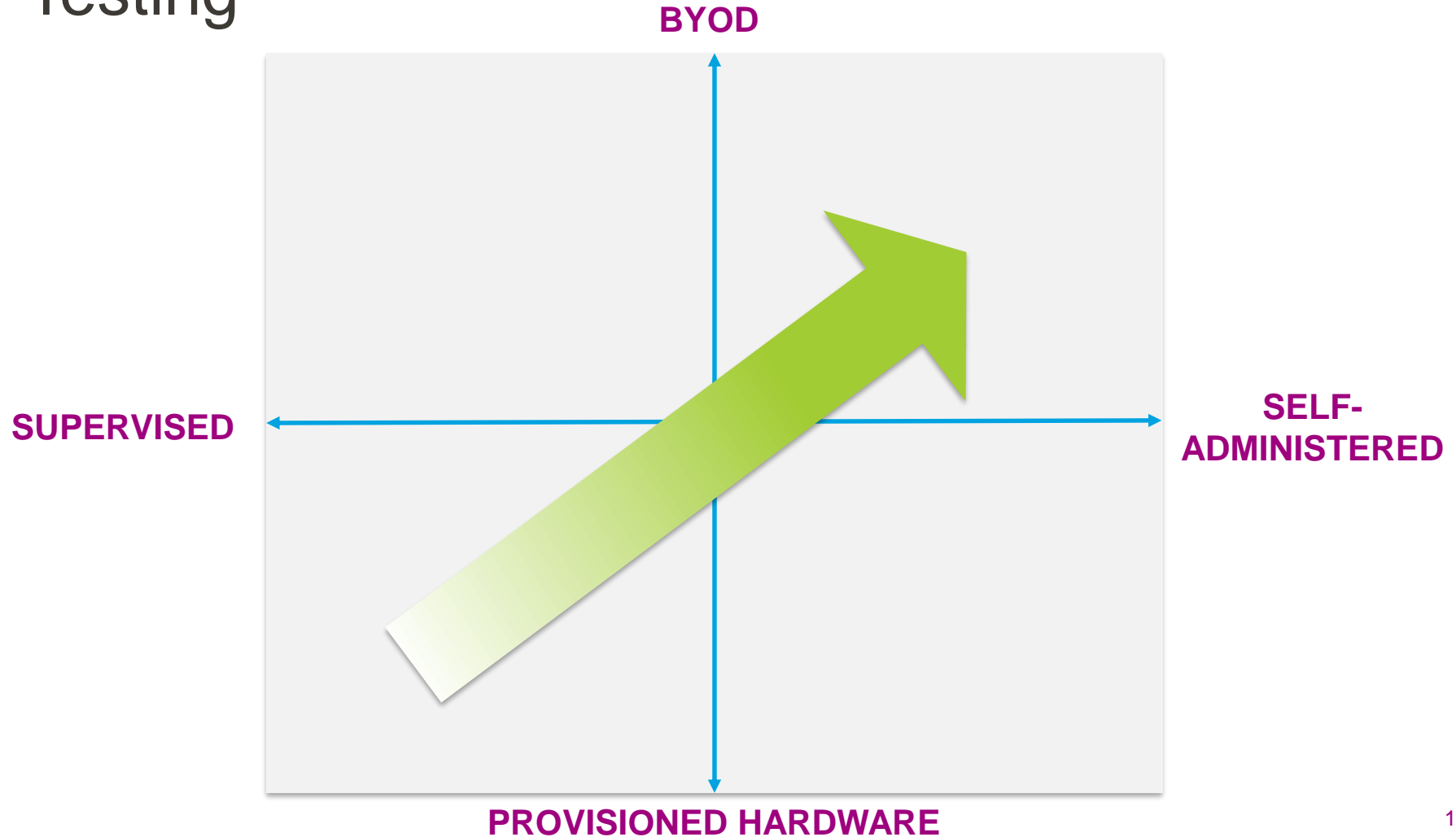
# Landmark Public-Private Partnership Studies



*Cogstate is proud to be involved in the measurement of cognitive function for multiple landmark public-private partnership studies in the area of Alzheimer's disease:*

- *DIAN Observational Study*
- *DIAN TU Study*
- *DIAN NexGen*
- *AIBL Study*
- *ADNI 2*
- *ADNI 3*
- *A4 Study*
- *GAP Foundation*

# Changing Landscape of Computerized Cognitive Testing



# Advanced Custom Reporting: Safety Monitoring & Inclusion Eligibility

- **Real-time automated analysis** of cognitive data
- **Immediate email notification** (alerts are sent to site for inclusion eligibility; alerts are sent to study monitoring teams when detecting cognitive decline)
- **Fully customized per study** based on the cognitive battery, visit schedule, and desired sensitivity





# Clinical Trials Solution #2: Scale Management Rater Training Central Monitoring

*technology and service solution for delivery,  
training and centralised review of  
standardised cognitive assessments*

# Rater Training Program Execution



**>65 studies**



**>35 countries**



**> 2,000 sites**

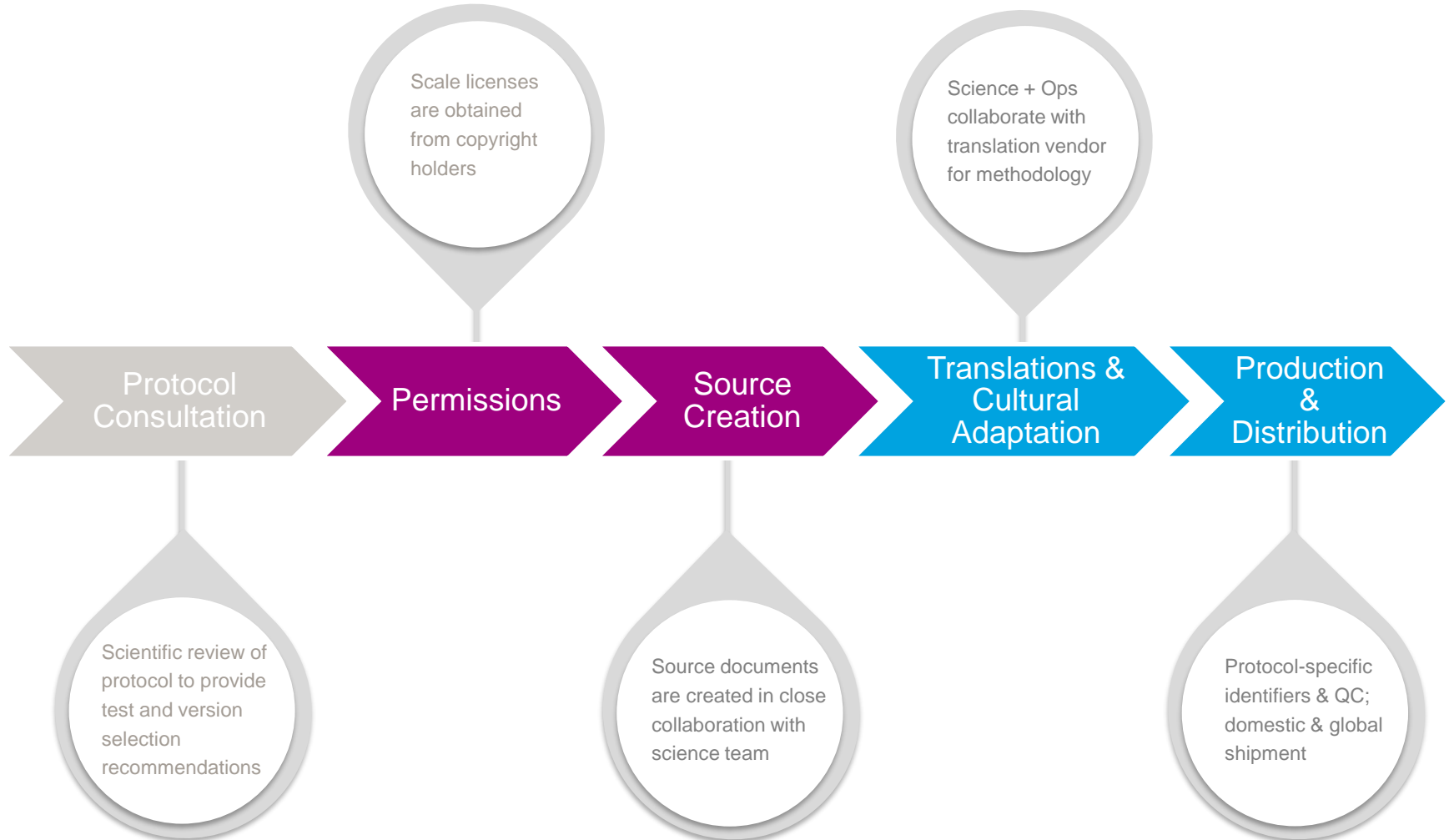


**>50 Languages**



**>4,000 Raters  
Certified**

# Scale Management Services





# Innovative Approach To Rater Training

Rethinking lecture-based rater training designed for the Investigator Meeting





# The Rater Academy Difference



- Immersive virtual training **accelerates site** activation, and minimizes site burden
- **Tailored eLearning paths** allow experienced raters to progress rapidly
- **Real-time visibility** of rater's training status allows timely scheduling of SIVs



- Multi-modality training **available throughout the study** drives accurate ratings (tell me, watch me, show me)
- **Localized content:** Avatars are more easily adapted to local culture and language
- Clinical guidance goes beyond the training sessions with **imbedded instructions and guidance** accessible within the tablet-based scale



- Effective eLearning and certification **reduces IM attendance**
- **“Library” of characters and backgrounds** for repurposing content
- **Maintains rater training and certification history** for optimized site/rater selection

A woman with curly hair, wearing a purple shirt, is sitting at a desk and writing on a tablet with a stylus. The background is a blurred office setting. The text 'Central Monitoring of Assessments' is overlaid in white on the image.

# Central Monitoring of Assessments

# Scientific Expertise Throughout Study



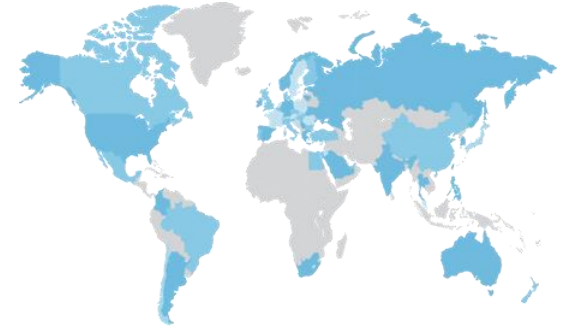
## Designing of Training and Monitoring Plans

Cogstate and external experts, test authors and KOLs dedicated to optimizing the measurement of cognition in clinical trials, from protocol design and test selection to monitoring algorithms and statistical analysis.



## Operational Execution

Across multiple disciplines from rater training to statistics, Cogstate has deep scientific expertise in neuropsychological and psychiatric testing in AD, Schizophrenia, Depression, Parkinson's, Oncology, Pediatrics and others.



## Monitoring and Rater Collaboration

Our network of Local Expert Advisors (LEADS) cover 30 countries; Neuropsychologists extensively trained on study scales to train, monitor and collaborate with sites throughout the study in their own language.

**Over 120 scientists and clinicians - from design through to interpretation.**

# Central Monitoring & Remediation – A Strategic Approach

**Despite robust training, many raters will make errors in the study**

**Quickly identify these rater errors**

**Prevent them from detrimentally impacting the quality/accuracy of the in-study assessments**

**Identify and correct scoring errors**

**Identify incorrect administration procedures**

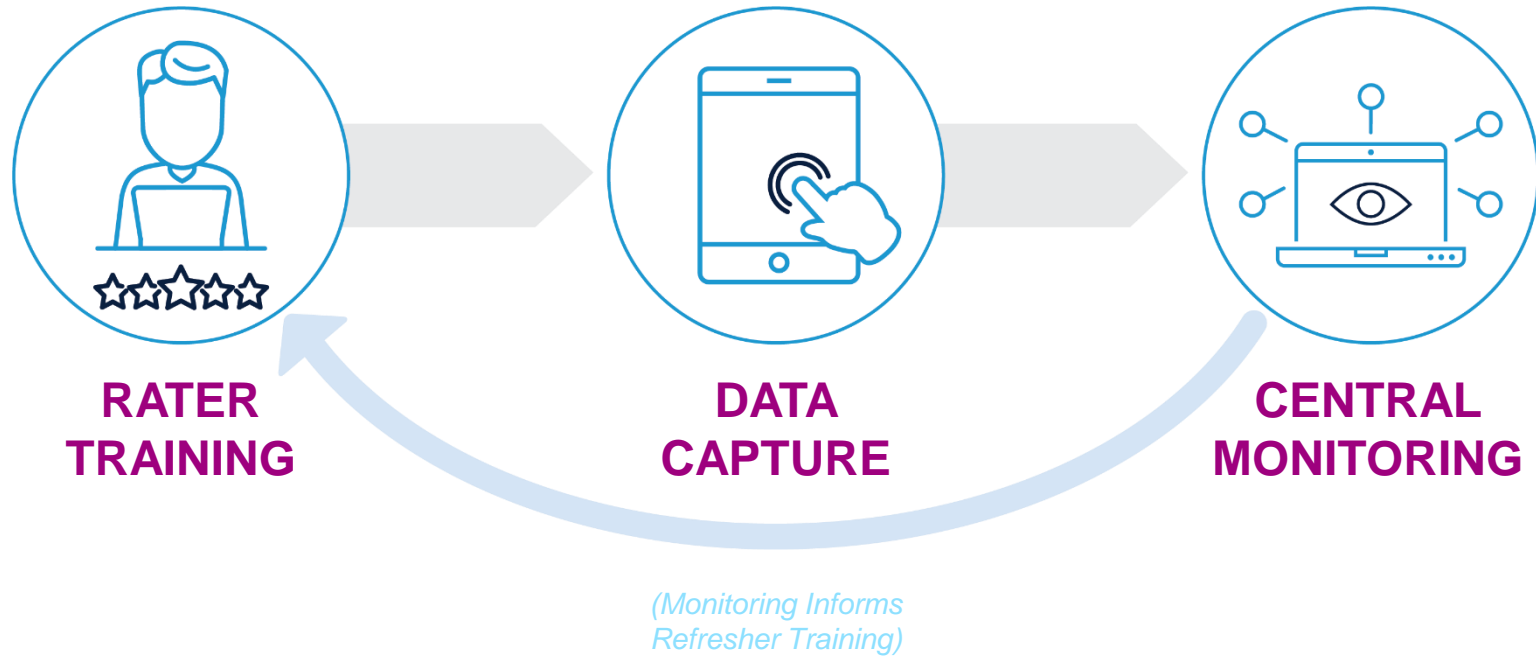
**Identify clinically unusual scores and abnormal change scores**

**Remediate**

Strategic approach  
to monitoring and  
remediation is  
adapted for the  
study and the  
endpoints.



# An Integrated Solution Drives Endpoint Quality Assurance

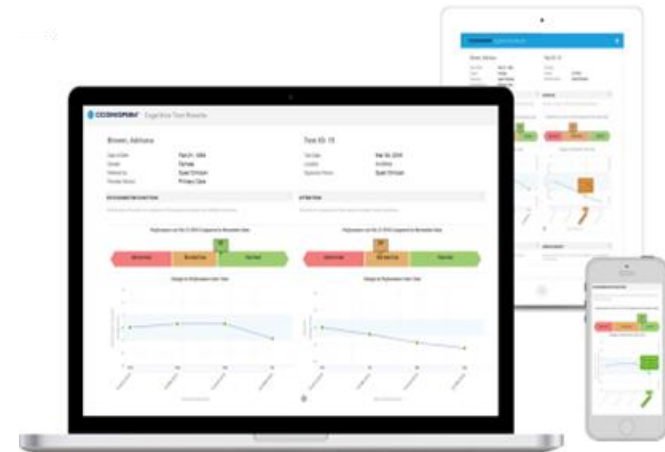


# Cognigram



# Current Offering

- 10-15 minute test for clinical care setting
- Can be taken at home or in hospital/clinic
- Assessment results instantly available to healthcare professionals
- Class II medical device
- [FDA 510(k) approved]
- HIPAA compliant



Sensitivity



Ease of use



Culturally  
neutral



Impairment  
& change



Wide adoption in  
drug clinical trials



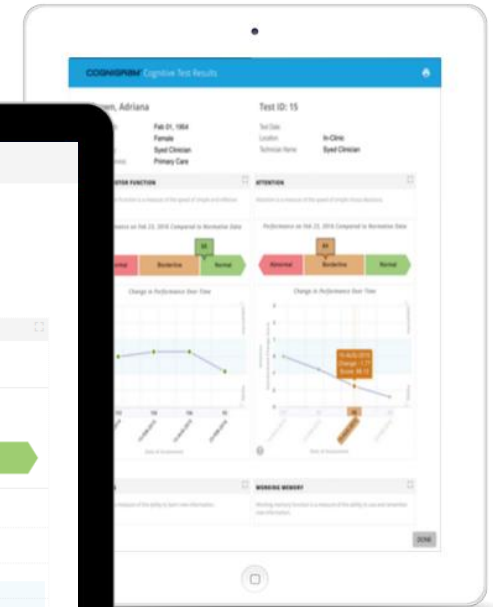
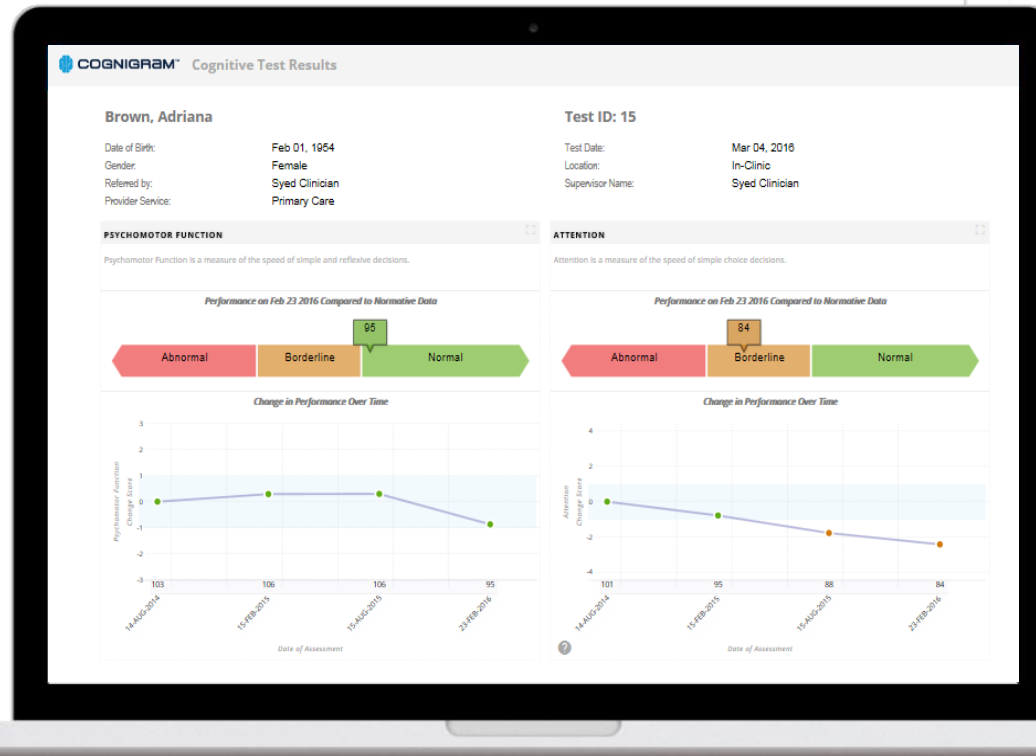
# Cognigram Report for Healthcare Professionals

*Patient & assessment  
order Information*

*Interactive results and  
data visualisations*

*Real-time baseline  
configuration and  
change score analysis*

*Composite scores  
(shown) and detailed  
outcome measures*



# Market Segments & Size

## Application

**Detect cognitive decline that could be signs of Alzheimer's or Mild Cognitive Impairment**



## Benefits

- early detection for disease management and clinical trial referral

**Monitor Drug Side Effect**



- evaluate cognitive state during/after drug therapy

**Assess Geriatric Surgery Risks**



- reduce risks for POCD (*post operative cognitive dysfunction*)
- lower hospital re-admissions and length-of-stay

**Evaluate Concussion**



- confirm concussion
- assess return-to-play readiness

**U.S. Market Has Potential for 40 Million Cognitive Tests Annually**

# Healthcare New Product Roll-Out Status



**Cognigram™**

The Cognigram™ system is a **simple and scientifically valid computerized test**, intended to aid healthcare professionals with **rapid assessment of cognition** in individuals aged 6 – 99 years old, is HIPAA compliant, and FDA reviewed.

 **Fast**
 **Informative**
 **Convenient**
 **Reliable**

 **Alzheimer's**

1 in 10 people aged 65 years or older has Alzheimer's disease. The Cognigram™ solution detects very subtle changes in cognition that could signify the early stages of dementia. Because neurological changes begin 20 or more years before disease symptoms become apparent, early detection of cognitive impairment is critical.

 **Surgery**

Post-surgical delirium affects up to 50% of surgical patients, costing \$164 billion per year. In the perioperative setting, delirium and postoperative cognitive dysfunction (POCD) occurs in up to 63% of patients over 65 years of age and in patients with moderate to severe cases, decline in cognitive function can be substantial and long term.

 **Concussion**

42 million people globally suffer from concussion each year. The Cognigram™ system offers unique value as a sensitive and reliable tool for baseline testing and post-injury evaluation. Sport organizations ranging from secondary education to professional and elite groups around the world depend upon its test battery for decision support in their concussion management programs.

HBM-0001 Ver. 1 

## Cognigram™ Global Market Entry Status



FDA authorization received



Health Canada authorization confirmed



Australia TGA authorization confirmed



CE Mark work-in-progress

Expected in 2018

**Cogstate Healthcare 1H FY18 Revenue >\$170k (Double Digit Growth vs. 1H FY17)**

# Growth Strategy- Concussion Market

## Leverage New Product Launch to

### Grow Revenue from Current Customers

#### Sample List of Existing Customers

##### Pro Sports



##### Healthcare



Aurora Health Care®



##### Colleges & Schools



UNIVERSITY OF  
MARYLAND



### Expand Customer Base

- Planning 3 global webinars featuring prominent users who are concussion thought leaders
- Exhibiting at the largest concussion conference in U.S.
- Exploring partnership for product integration and commercialization

# Growth Strategy- Surgery/POCD

- Post-operative delirium and cognitive dysfunction are common clinical complications among elderly patients
  - Prevalence: 30-60% elderly patients suffer from post-surgery delirium
  - Cost: delirium causes significant economic burden to society (costing U.S. \$164 billion annually)
- Emerging clinical evidence substantiating Cogstate technology's clinical superiority related to POCD detection (*see appendices*)
- Our 2018 POCD growth execution includes educational events and exhibits to establish leadership position in this untapped market opportunity

# Technology Developments



# Tech Accomplishments (6 Months)

Accomplishment	Benefit	Description
Release of Cognigram	Market Expansion	Expansion of overall Cogstate market with 510k approved application.
Pre-screener Reporting	Customer Satisfaction	Additional reporting options for pre-screener customers.
Platform Early Adopter	Margin Improvement	Launch of new clinical trials platform with modernized tests and Electronic Data Capture (EDC) to drive internal efficiency and scale.
Performance Enhancements	Scale	Ability to scale performance of the underlying test processing technology to deliver larger clinical trials including consumer sized.
Instructor Learning Management System	Market Expansion	New technology deployed to deliver rater training creating new capabilities to grow that market.

# Cogstate Technical Strategy

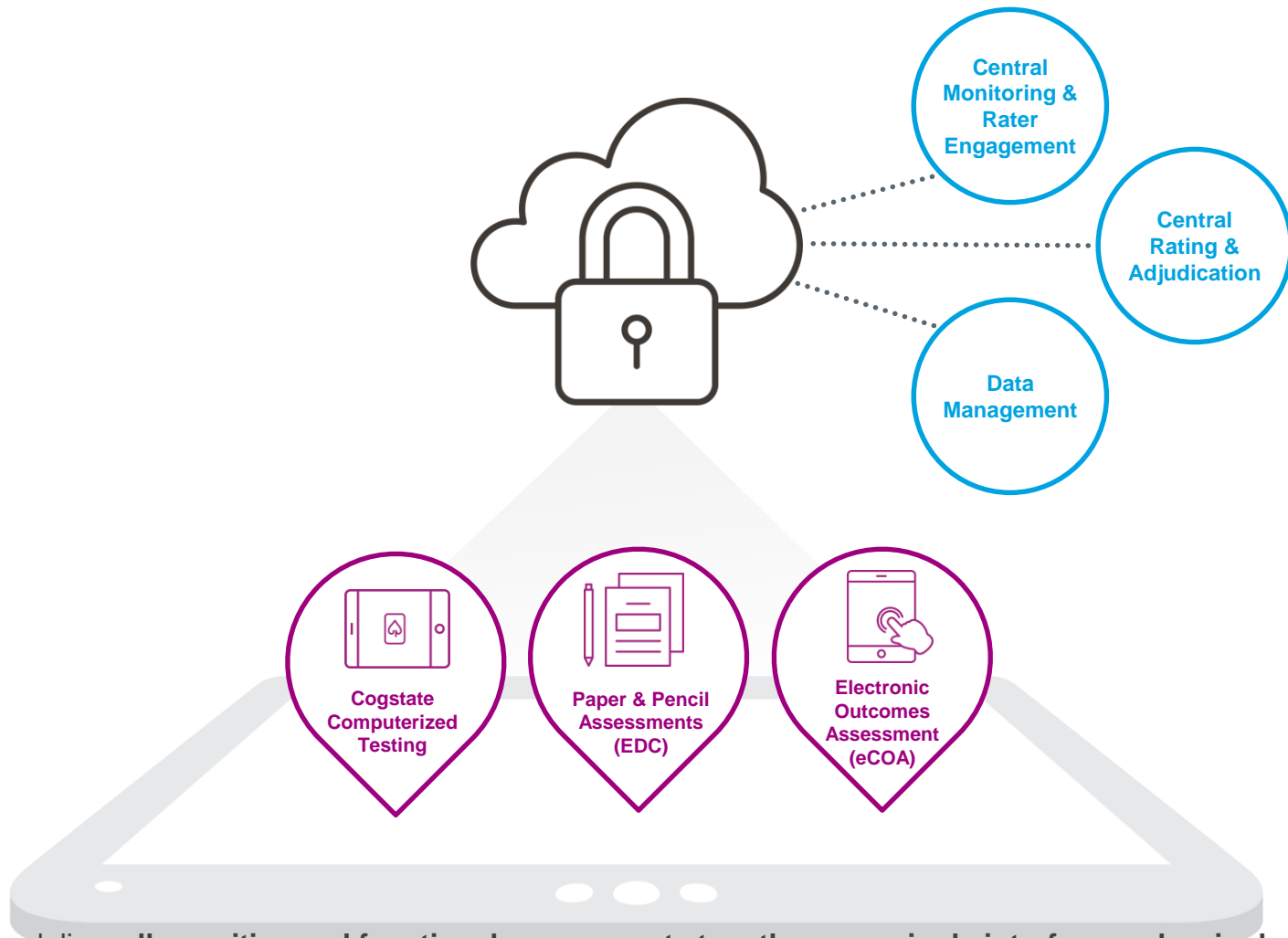
We are going to continue to build out our modular cognitive platform adding support for new therapeutic markets, channels and customer applications to deliver our Cogstate services to the market increasing speed, efficiency and quality.

- Additional eCOA<sup>1</sup> capabilities to support more complex scales<sup>2</sup> utilizing pen based entry.
- Support the integration of Cogstate computerized tests onto other channel partner hardware.
- Build out scales and computerized tests to support expansion into Depression, Oncology, and Early Phase.
- Innovate to build and support new test types, modalities (Audio, Virtual Reality, Wearables) and 3<sup>rd</sup> party created assessments.

*1: eCOA: electronic clinical outcome assessment – digital delivery of assessments and digital data capture*

*2: Scales: standardised cognitive assessments*





A single platform to deliver **all cognitive and functional assessments together on a single interface and a single data management solution** – resulting in time, cost and quality benefits to the sponsor and a better experience for the sites and patients.

# Financial Performance

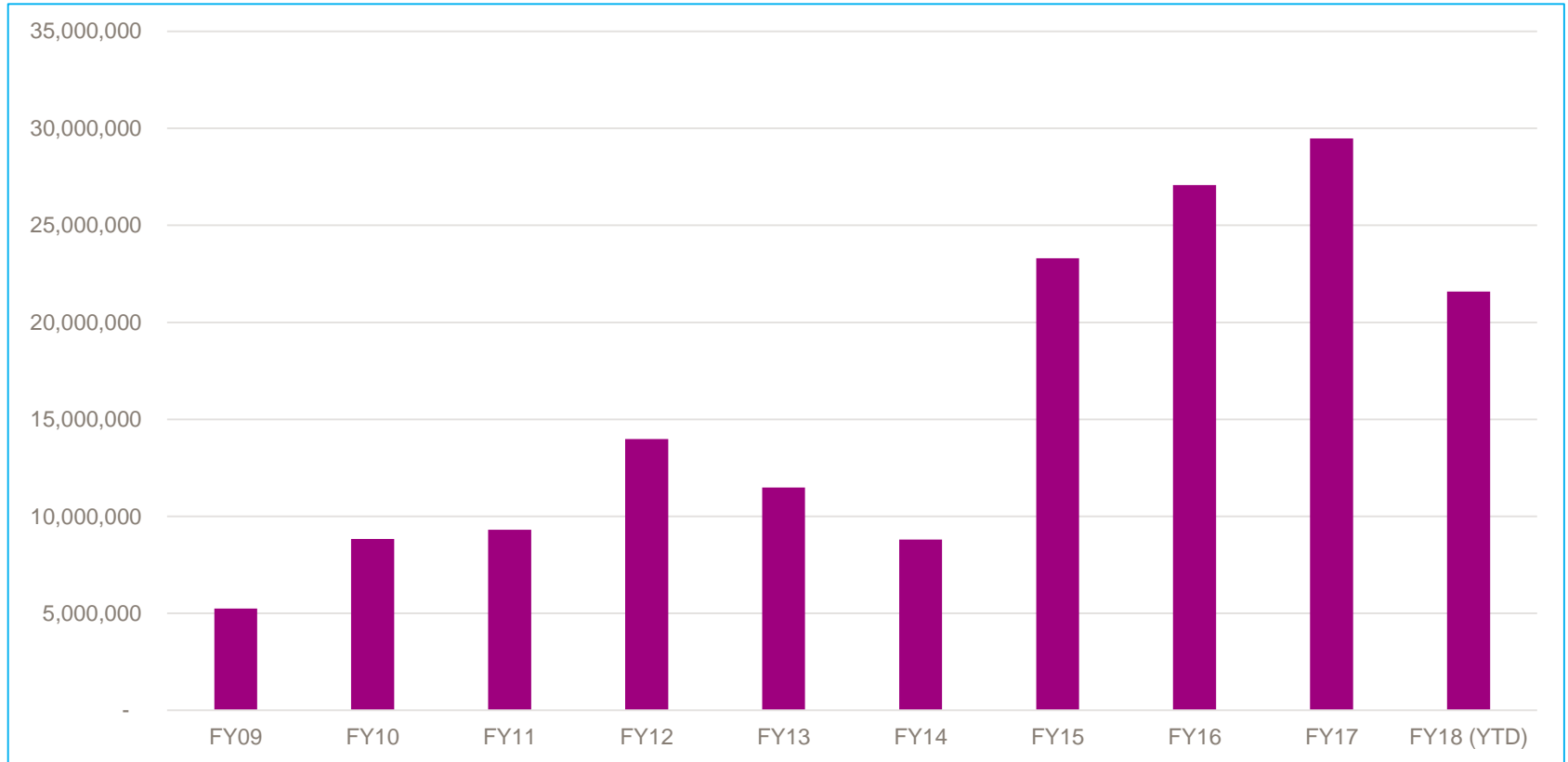


# Financial Update

## Delivering Against Plan

- \$21.6 million in new bookings for half year
  - Nicely diversified portfolio of clients: *ongoing studies represent awards from 31 different customers*
  - Important win with the Global Alzheimer's Program (GAP): *announced Jan 2018*
  - Continued strong relationship with strategic partners
- Revenue slightly below target due to timing issues
  - Expected to recover and be on track for the full year
- Working to improve operational efficiencies
  - New technology platform is on track for delivery in Q4
  - Rater Academy infrastructure is up an running and in use on studies
- Expanding scientific expertise and capacity

# Clinical Trial Sales Contracts

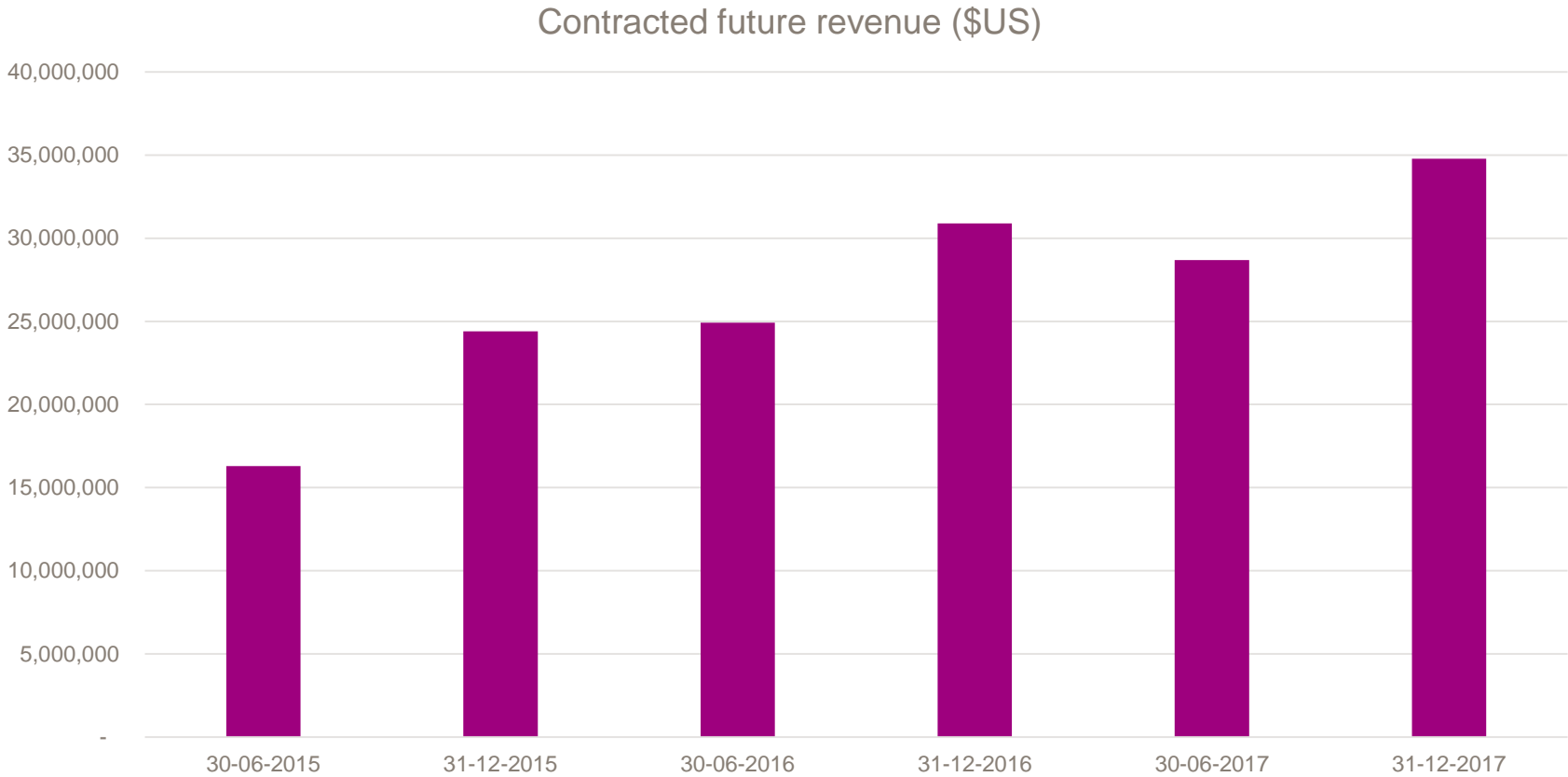


## Notes:

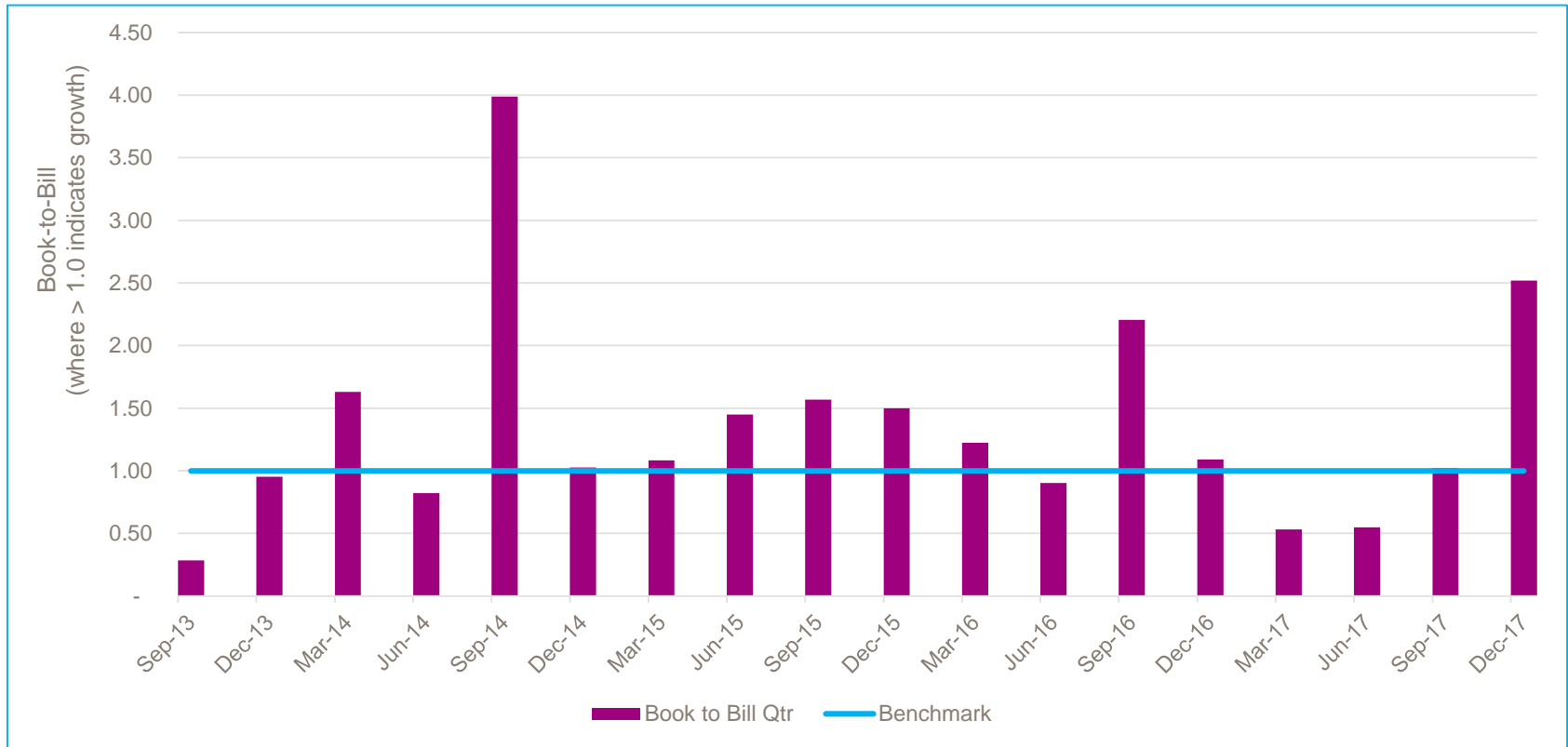
Financial Year runs 1 July – 30 June

FY18 (YTD) represents the 6 months to 31 December 2017

# Contracted Revenue Backlog



# Clinical Trials: Book-to-Bill Analysis



# FY17 Summary Financial Performance

Financial Performance	FY17 (AUD)	FY16 (AUD)
<b>Clinical Trials</b>		
Revenue	34,652,048	27,140,935
Cost of sales	(11,431,759)	(7,911,432)
Gross Margin	23,220,289	19,229,503
Selling, General & Admin costs	(4,186,511)	(3,441,848)
Pass-through costs, net of recovery	58,269	(12,487)
<b>Clinical Trials contribution</b>	<b>19,092,047</b>	<b>15,775,168</b>
<b>Healthcare (incl. Sport)</b>		
Revenue	272,850	90,814
Cost of sales	(1,117,942)	(528,232)
Other operating expenditure	(387,456)	(529,990)
<b>Healthcare contribution</b>	<b>(1,232,548)</b>	<b>(967,408)</b>
<b>R&amp;D (incl. academic research studies, normative data studies and new technology validation)</b>		
Revenue	16,674	20,306
Cost of sales	(90,653)	(52,914)
Other operating expenditure - Salaries & Wages	(679,933)	(527,442)
<b>R&amp;D contribution</b>	<b>(753,912)</b>	<b>(560,050)</b>
Product Development & Quality Assurance	(5,563,221)	(4,109,216)
IT Infrastructure	(1,398,006)	(1,096,139)
Share based payments	(959,213)	(175,860)
Office & Facilities	(1,078,446)	(686,774)
Other operating expenditure *	(8,619,475)	(7,557,493)
Other income, incl. R&D tax rebate	44,006	565,169
Interest Income	74,463	79,787
Net foreign exchange losses	(422,311)	(228,404)
<b>Other Expenditure (Net)</b>	<b>(17,922,203)</b>	<b>(13,208,930)</b>
<b>Net (Loss)/Profit before tax</b>	<b>(816,616)</b>	<b>1,038,780</b>

\*Other operating expenditure, includes employment expenses of A\$4.9m (FY16 A\$4.6m) inclusive of Board, CEO, COO, Finance team, Legal team, administrative and temporary staff. Those employment expenses are expected to remain consistent from FY17 to FY18.

Additional items included within "Other Operating Expenditure" includes depreciation, professional fees, travel, marketing, insurance and ASX/Registry costs.



# Leadership & Expertise



# Management

## Brad O'Connor CEO

- Managing Director and **CEO** of Cogstate **since 2005**
- Previously **CFO** of Cogstate; chartered accountant who holds a Bachelor of Business degree

## George Hunnewell COO & President of Clinical Trials

- **25 years experience** growing healthcare technology businesses; **general management expertise** in sales, marketing, operations, finance, and M&A
- Previously the Corporate VP, Clinical Research Services for **Parexel International, one of the largest CROs in the world**

## Frank Cheng President of Healthcare

- More than **23 years experience** in the global medical device technology and diagnostic industries
- Previously the SVP, Worldwide Marketing & BD at **Stereotaxis Inc, publicly-traded robotic heart surgery company**

## Lammert Albers Chief Commercial Officer

- More than **15 years experience** in the life sciences and healthcare industries
- Previously the SVP of global BD and Engagement Partner at **PRA Health Sciences**

## Paul Maruff Chief Science Officer

- **Co-founder** of Cogstate; active neuropsychologist and professor at the **Florey Institute for Neuroscience and Mental Health**
- Has worked extensively on methods for **identification and pharmacological treatment of subtle neurocognitive impairment**

## Richard Gleeson Chief Technology Officer

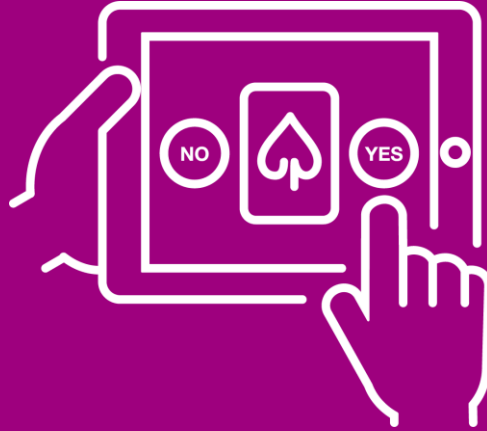
- **20 years experience** building technologies for healthcare and life sciences industries
- Previously VP, Global Solution Delivery at **Parexel Informatics**

# Board of Directors

		Audit, Risk & Compliance Committee	Remuneration & Nomination Committee	
<b>Martyn Myer</b>	Non-Exec Chairman	Yes	Chair	Founding Director and substantial shareholder
<b>Brad O'Connor</b>	Chief Executive Officer	N/A	N/A	CEO since December 2005
<b>David Dolby</b>	Non-Exec Director	No	Yes	Substantial shareholder and significant supporter of Alzheimer's disease research and technology
<b>Rich Van Den Broek</b>	Independent Non-Exec Director	No	Yes	US fund manager with investment emphasis on small and mid-cap biotech public companies
<b>Dr. Richard Mohs</b>	Independent Non-Exec Director	Yes	Yes	Experienced scientist with extensive academic and industry (big-pharma) experience
<b>Jane McAloon</b>	Independent Non-Exec Director	Chair	Yes	Experienced executive with extensive corporate and governance experience



Cogstate



Appendices:

# Cogstate’s Clinical Superiority in Detecting Post Operative Cognitive Dysfunction (POCD)

## Feature Publication #1

**Detection of Cognitive Decline After Coronary Surgery: A Comparison of Computerized and Conventional Tests**  
*British Journal of Anaesthesia* 92 (6): 814±20 (2004)  
Silbert et al (Dept. of Anaesthesia, St. Vincent’s Hospital, Melbourne, Australia)

**Study Aim** Determine whether this [Cogstate] computerized test battery could detect postoperative cognitive decline after CABG surgery in the immediate postoperative period and to compare the sensitivity with that of conventional neuropsychological tests.

**Methods**

**Patients (all >54 years old)**  
Group A: 50 patients underwent coronary artery bypass graft surgery (CABG)  
Group B: 50 healthy patients in age-, IQ- and education-matched control group

<u><b>Cogstate Computer Battery</b></u>	<u><b>Conventional neuropsychology Tests</b></u>
• Detection (reaction time)	• Cerad Word Learning Test
• Identification (reaction time)	• Symbol Digit Modalities Test
• Matching (accuracy)	• Trail Making Test (Part A, Part B)
	• Semantic Fluency Test
	• Grooved Pegboard Test

### 1. Test-Retest Reliability... “The computer tests were more reliable than the conventional tests”.

**Results**

**Table 3** Test-retest reliability at 6 days in healthy control group (n=50)

Test battery	Intraclass correlation
Conventional	
Word learning test (n words)	0.63
Symbol digit modalities (n boxes)	0.69
Trail Making A (s)	0.64
Trail Making B (s)	0.69
Semantic fluency (n words)	0.56
Grooved pegboard (s)	0.71
Computerized	
Detection reaction time (log <sub>10</sub> ms)	0.91
Detect accuracy (% correct)	0.61
Identification reaction time (log <sub>10</sub> ms)	0.89
Identification accuracy (% correct)	0.71
Matching reaction time (log <sub>10</sub> ms)	0.92
Matching accuracy (% correct)	0.89

“There were minimal practice effects for reaction time or accuracy on the computer measures”

# Cogstate's Clinical Superiority in Detecting Post Operative Cognitive Dysfunction (POCD)

## Feature Publication #1 (Continued)

### Detection of Cognitive Decline After Coronary Surgery: A Comparison of Computerized and Conventional Tests

*British Journal of Anaesthesia* 92 (6): 814±20 (2004)

*Silbert et al* (Dept. of Anaesthesia, St. Vincent's Hospital, Melbourne, Australia)

#### Results (cont'd)

#### 2. Sensitivity & Specificity for POCD Detection

- “The computerized battery detected all the cases of POCD identified by the conventional test battery and also 5 cases that were classified as normal by the conventional tests”
- “If the conventional tests were considered as the gold standard, then the sensitivity of the computer tests would be 100% and the specificity 85%”
- The authors believe that the additional cases of postoperative cognitive decline identified on the computerized battery may be true cases

**Therefore, Cogstate computer battery's specificity may be nearing 100%, in addition to its Confirmed sensitivity of 100%**

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#### Conclusion

**[Cogstate] computerized tests are suitable for measuring cognitive change after CABG Surgery, are easy to administer and analyze, and may detect change in a greater proportion of patients 6 days after CABG surgery than conventional neuropsychological tests.**

# Cogstate’s Clinical Superiority in Detecting Post Operative Cognitive Dysfunction (POCD)

## Feature Publication #2

**Assessment of Cognitive Function Before and After Surgery for Posterior Cranial Fossa Lesions Using Computerized and Conventional Tests**  
Neurol Med Chir (Tokyo) 50, 441-448, 2010  
*Ichimura et al (Keio University School of Medicine, Tokyo, Japan)*

**Study Aim** Examines the changes in higher brain function after neurosurgical procedures for posterior fossa lesions, using both conventional and computerized tests.

**Patients (all 23- 72 years old)**  
50 patents who underwent neurosurgery for cranial fossa lesions

<b>Methods</b>	<b><u>Cogstate Computer Battery</u></b>	<b><u>Conventional neuropsychology Tests</u></b>
	<ul style="list-style-type: none"><li>• Psychomotor function test</li><li>• Attention test</li><li>• Learning test</li><li>• Continuous monitoring test</li></ul>	<ul style="list-style-type: none"><li>• Serial 7-Word Learning Test</li><li>• MMSE</li></ul>

1. Sensitivity for POCD detection
- “The computerized tests detected all patients who showed worsened scores in the conventional tests”
  - “The computerized tests detected significantly more patients with decreased or worsened scored than the conventional tests (p<0.05)”

**Results**

**Table 2 Results of the computerized and conventional tests**

	Computerized tests		Conventional tests	
	Response time	Accuracy	Serial seven-word learning test	MMSE
Unchanged/improved	15	13	31	38
Decreased/worsened	35*	37*	19	12

\*In comparison with the conventional tests, the computerized tests detected significantly higher numbers of decreased or worsened scores (p<0.05). MMSE: minimal state examination.

# Cogstate's Clinical Superiority in Detecting Post Operative Cognitive Dysfunction (POCD)

## Feature Publication #2 (Continued)

### Assessment of Cognitive Function Before and After Surgery for Posterior Cranial Fossa Lesions Using Computerized and Conventional Tests

Neurol Med Chir (Tokyo) 50, 441-448, 2010

*Ichimura et al (Keio University School of Medicine, Tokyo, Japan)*

#### 2. Practice Effect

- “The present study observed practice effects in the MMSE scores. Repeated assessments with the same conventional test often lead to an improvement in the performance, which can obscure the precise changes in the central nervous system”
- “The computerized test, Cogstate™... is cultural-neutral and not limited the subject's level of education or social-economic background, and so can be adopted to minimize the practice effect”

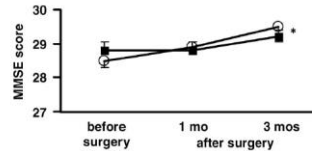


Fig. 4 Changes in the mini-mental state examination (MMSE) scores before and after surgery. In both the middle fossa (squares) and lateral suboccipital groups (circles), the MMSE scores 3 months after surgery had significantly improved in comparison with the scores before surgery (\* $p < 0.01$ ). The vertical bars indicate standard errors.

#### Results (cont'd)

#### 3. Test Efficiency

- “The computerized test might also be useful for evaluation of the patients after surgery because of the quick and effortless completion... computerized test takes only 15-20 minutes”
- “The WAIS-R and Wechsler Memory Scale-Revised, for example, take approximately 90 and 60 minutes, respectively, to complete and could impose considerable burdens on patients after surgery”

#### Conclusion

The [Cogstate] computerized tests could be performed easily and were beneficial for detecting subtle changes of the cognitive function after surgery.



# Cogstate’s Clinical Superiority in Detecting Post Operative Cognitive Dysfunction (POCD)

## Feature Publication #3

**Indication of Cognitive Change and Associated Risk Factor after Thoracic Surgery in the Elderly: A Pilot Study**  
*Frontiers in Aging Neuroscience* (December 2017, Volume 9, Article 396)  
*Kulason et al* (Tohoku University, Tokyo, Japan)

Study Aim	Examine the cognitive changes after major thoracic surgery and utilizes the MMSE in conjunction with several other measures including a computerized battery to detect changes in cognitive function	
Methods	<u>Patients (all &gt;60 years old)</u> 12 patents who underwent lung surgery with general anesthesia	
	<u>Cogstate Computer Battery</u> <ul style="list-style-type: none"><li>• Cogstate Brief Battery, the core technology that Cognigram™ system is based on</li></ul>	<u>Conventional neuropsychology Tests</u> <ul style="list-style-type: none"><li>• MMSE</li><li>• Frontal Assessment Battery (FAB)</li></ul>
Results	<ul style="list-style-type: none"><li>• “... a significant correlation between the decline in [Cogstate] IDN and baseline GHD-12 scores. The mental well-being of the patient prior to surgery is potentially a predictor of POCD... The finding adds further support to Leung et al’s (2005) conclusion that preoperative depression is a risk factor for the events on this spectrum”</li><li>• “... changes in in [Cogstate] OBK scores were significantly correlated with anesthetic duration (p= 0.012)”</li><li>• “... present study detected no change in MMSE scores”</li></ul>	
Conclusion	The results of this study suggest that it is possible to detect declines in two different domains, [Cogstate] processing speed and visual attention, 1 week after surgery	